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The Chemical Age

VOL LXIV 17 MARCH 1951 No 1653

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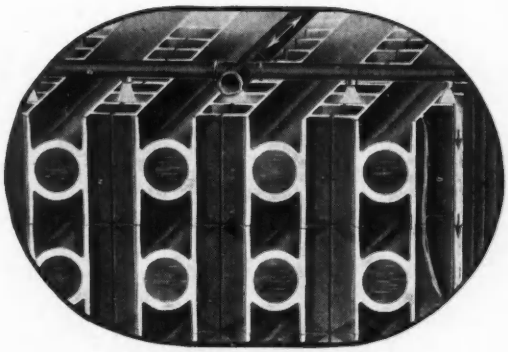

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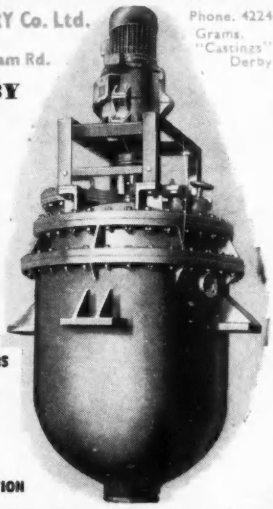

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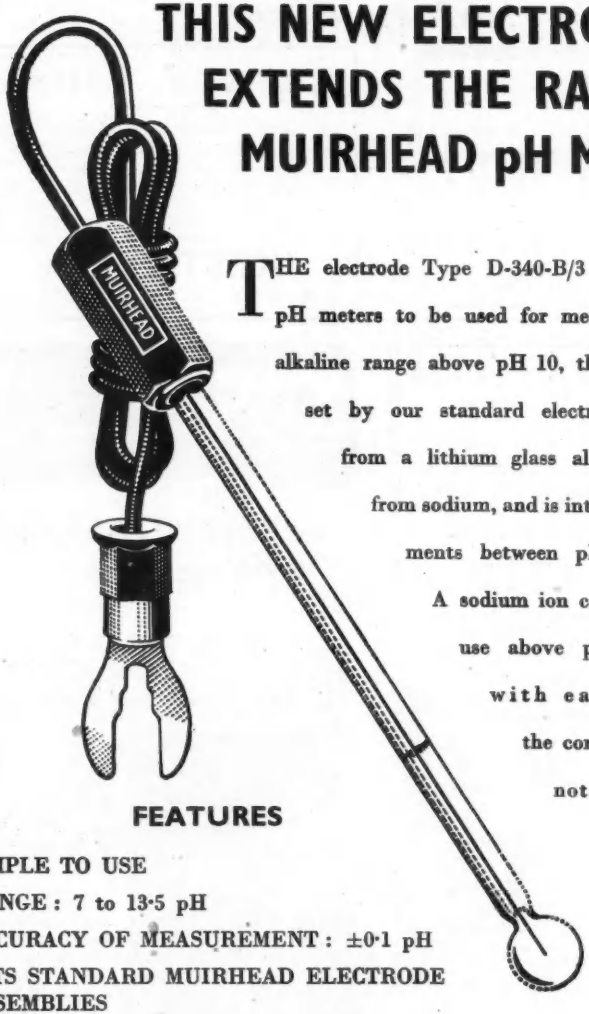

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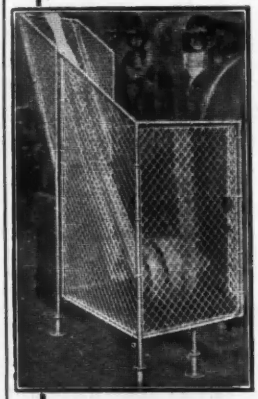

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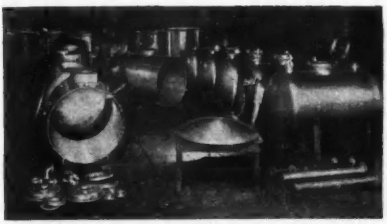

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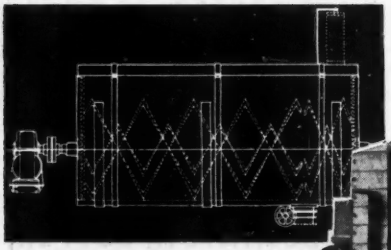

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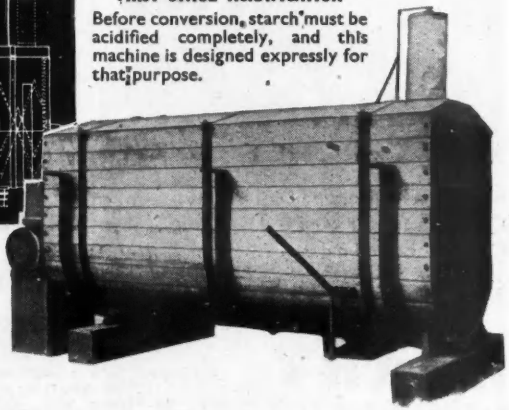

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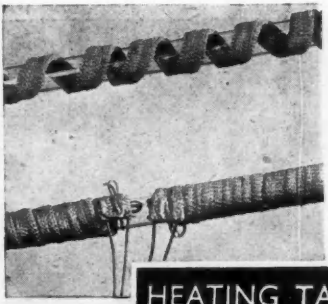

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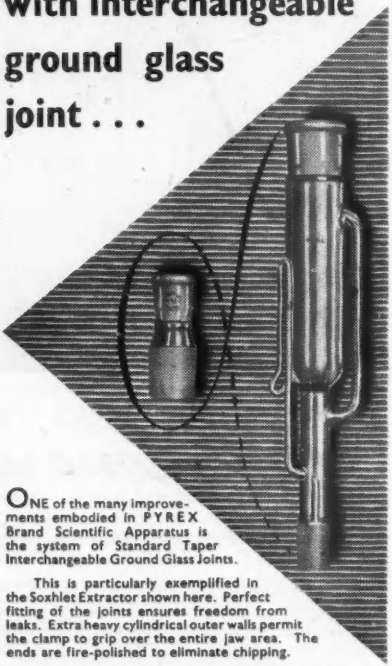

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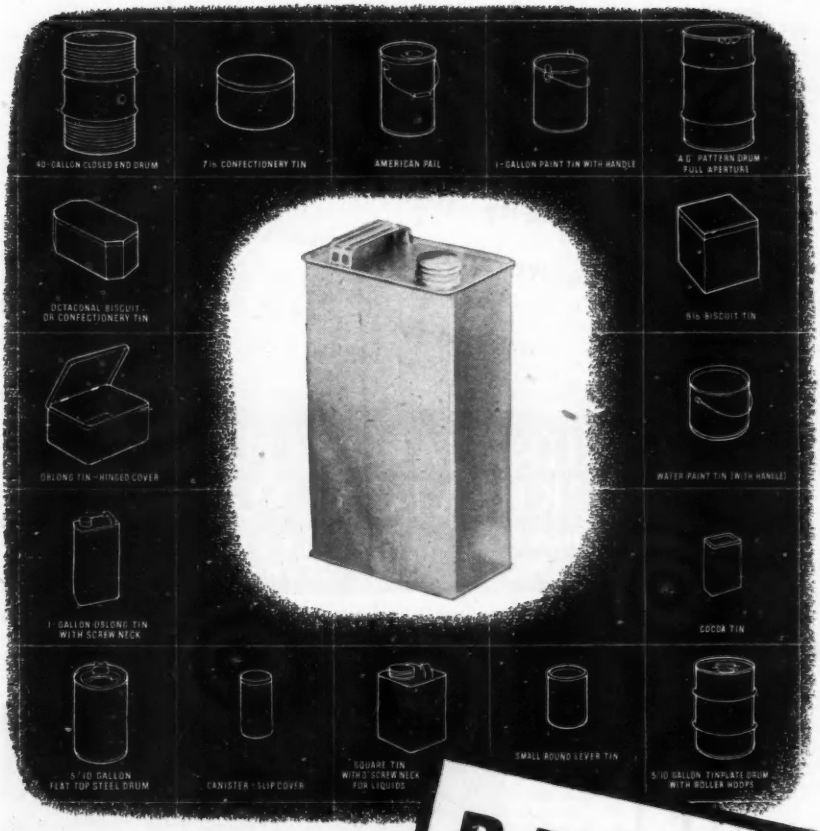
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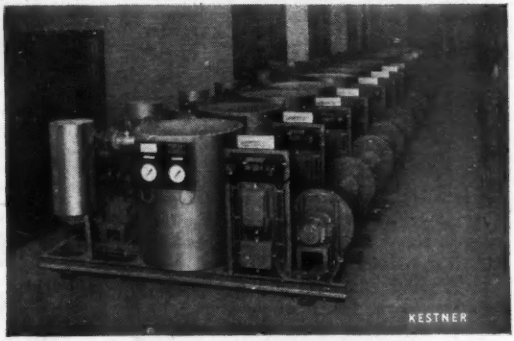

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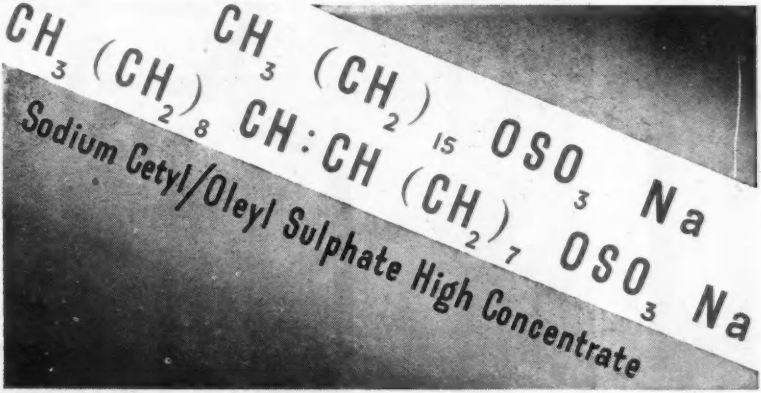

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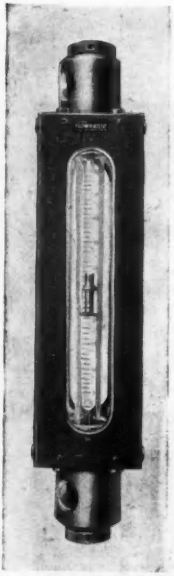

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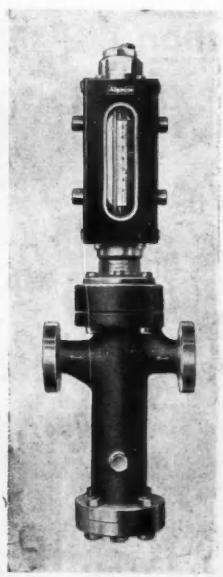

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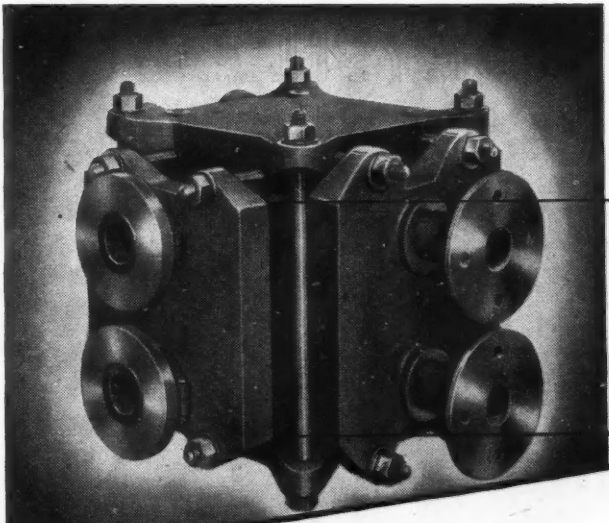

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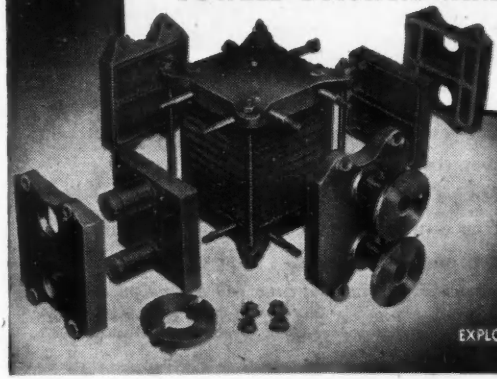

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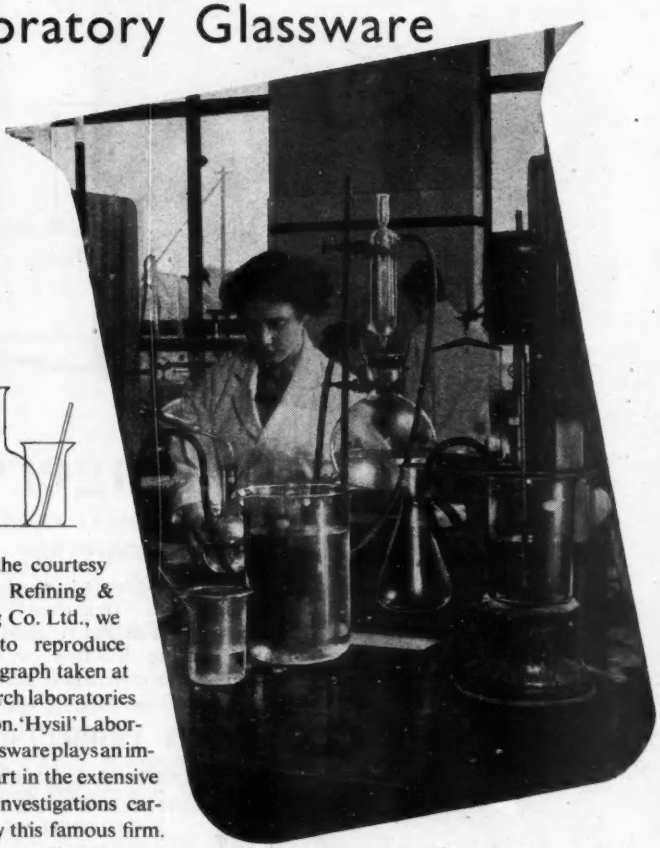

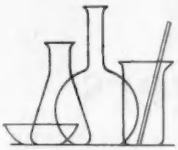

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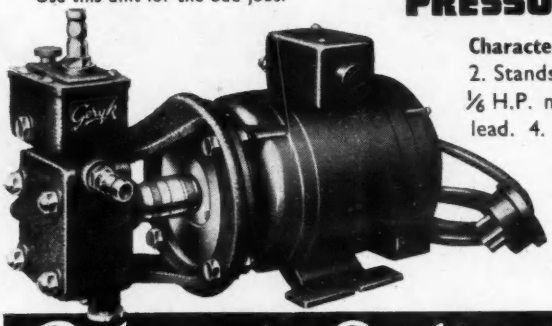

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The Chemical Age

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Fertiliser Recession?

ONE of the notable sectors of chemical progress during the war and the early post-war period was that of fertilisers. Both demand and production swept forward. There was always the possibility that the rate of expansion would slow down, but there are now grave fears that in fact there may be some recession. The loss of any of the progress made in the past ten years will not only be a blow for the fertiliser industry—it will be a grievous set-back for the technical progress of this country. Even at the crest of the recent expansion, fertilisers were not being over-used. In arable farming rates of dressing had steadily risen, but they were still, in average terms, considerably below the optimum rates advised by independent agricultural scientists. On grassland they were minute. Scientifically the task of expanding fertiliser use was far from achieved. Leading authorities like Sir John Russell, Sir William Ogg, Professor T. Wallace, and Dr. E. M. Crowther had persistently urged further expansion.

The disappointing turn in events is not due to one influence alone. The situation can fairly be described as complex. For that reason it is all the more dangerous. While most sensible people would have agreed that it was nationally right to relieve the post-war pressure of mounting subsidies, the 1949 decision to discard the fertiliser subsidies in 1950 and 1951 by a two-stage process was a controversial economy. It involved adding in little more than one farming year all the postponed cost advances of ten inflationary years; had such sharp changes in fertiliser economics ever been envisaged, it would have been far wiser to allow fertiliser prices to rise steadily during the long period of pegged prices. In 1949 fertilisers were cheaper than in 1939; their prices per ton were a little higher, but the improvement of granulation had been added to quality for the most popular grades. De-subsidisation should have begun earlier; or, when introduced, it should have been more gradually imposed. The first stage, last July, added approximately £3 to fertiliser prices; more in some cases, less in others. Since then many production costs have risen further and the final stage of de-subsidisation, due this July, must inevitably represent a far from small addition to present prices.

There is little doubt that farmers have been discouraged by the price increases already made. These have come at a time when many other aspects of farming economy are being tightened; and the exceedingly bad harvest of 1950 intensified the discouragement. Nevertheless a new subsidy scheme applying to

fertilisers used for grassland had been introduced and this seemed to temper the blow for the very type of fertiliser usage that most required expansion. In February, before this new scheme's effectiveness could be assessed, the Minister of Agriculture announced its withdrawal as from the end of June. A determined attack upon all economic encouragement for increasing or maintaining our soil fertility would seem to have become official policy. It can be replied that these removals of subsidies will receive due compensation in the regular reviews of farm produce prices, but there are few farmers who would regard this as a *quid pro quo* reality. The present accumulation of farmers' increased costs is so great that it is difficult to see how farm produce prices can rise equivalently; if they do, the *consumers'* food subsidies or food prices must rise sharply.

Yet the sulphur shortage has already severely reduced production. The biggest consumer for sulphuric acid was the fertiliser industry. There is, in fact, some shortage of fertilisers this spring as a result. This might seem to vindicate the first stage of de-subsidisation. Indeed, but for considerable imports of Continental superphosphate the current shortage would be much more acute. The next agricultural year, 1951/52, may well see much sharper reductions in both home production and imports. There may be, therefore, a factual balance between available supply and price-discouraged demand. Yet it would be a balance wholly unrelated to the needs of soil productivity, a trading level unhealthily and far below the desirable level that agricultural science would prescribe. If the pattern of supply and demand became stabilised for two or three years at this sub-scientific level, a great deal of the technical impetus of the past decade of progress will inevitably be dissipated. That is a loss which cannot be measured in the columns of economic accountancy. Let it not be forgotten that the country, through its past fertiliser subsidies and its agricultural research and advisory services, has invested large sums in that technical progress.

Is it too late for the second and final stage of fertiliser de-subsidisation to be deferred or scrapped? A demand that exceeds supply is not an embarrassment —it is still an expression of purpose. A balance of low supply and low demand would represent an expression of apathy. Also, the sulphur crisis presents severe problems to the industry. New and more costly pathways to sulphuric acid must be opened; better still, new fertilisers that can be made without using this acid must be developed. These are large tasks and they will require significant expenditure of effort and capital. The certainty of high-level demand is a necessary stimulation for all this.

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Notes & Comments

Research Associations

OUR distinguished contemporary, the scientific monthly *Discovery*, has drawn attention to Sir Ben Lockspeiser's outspoken speech at the PATRA (Printing, Packaging, and Allied Trades Research Association) annual luncheon. The secretary of the DSIR pointed out that the printing industry with a turnover of £98 million per annum was contributing only £21,500 to the research association; and, although the nation's packaging bill was some £300 millions a year, the packaging industry contributed only £8,500 per annum. He described this as a "sip of science" which, like the small servant's sip of beer in the "Old Curiosity Shop," was too small to signify actual taste. It is a great pity that industrial research associations were not set up many years ago, for some of the difficulty in acquiring contributions is due to the modern pattern of industry, a pattern that has in most cases come into existence before the setting-up of research associations under D.S.I.R. ægis. The process of merging or rationalisation took place very extensively between the two wars. In many industries a substantial proportion of the total annual trade is conducted by a few large businesses or combinations. Not only do these large businesses undertake their own research but, on any system of levy payments for the research association such as Xd. per ton of output or Xs. per £100 of turnover, their large share of the industry's turnover involves them in proportionately heavy payments towards the research centre's upkeep. They not unnaturally feel that they are paying for research both ways unless the costs of the general research project are kept on a moderate scale. Though more often discussed privately than publicly, this problem of the industrial research association is very real. The principal beneficiary within an industry is apt to be the very small company which is too small to conduct any private research and whose small turnover involves only a modest contribution by way of levy. By contrast, the very big company pays a large share towards the research association's costs but, having already developed its own research laboratories, may not often need to take problems to the association. Whether this dilemma is responsible for keeping the funds of some industrial research associations at what seems a low level may be a matter of opinion but it has certainly prevented or delayed the formation of such associations in some industries.

Colonial Development

ALL who believe (and there can be few who do not) that Britain's major long-term contribution towards a safer and better world is the steady development of the colonies will welcome the new *Times Review of The British Colonies*. With the first issue this month, quarterly publication begins. *The Times* is not merely a great newspaper—it is a world-respected British institution; buts its daily renown tends to overshadow its modern policy of issuing specialised and journal-like supplements regularly surveying progress in this and that field of human activity. The potential contribution of science to colonial development seems likely to be given a proper emphasis in the new quarterly supplements. The first issue is certainly not lacking in scientific background. The problems of expanding technical education in Africa are given a separate article; in this the interesting point is made that native education was pioneered by missionary organisations, which has resulted in an over-emphasis upon the arts and clerical subjects. The balance of education in Africa reflects the old balance of nineteenth century Britain, and the ambitious native is apt to find more honour in the desk and ink-well than in the fitter's shop or the chemical factory. No doubt they have so far seen more of our bureaucracy than of our modern industry. In this respect, a second article describes the rapid industrialisation now taking place in Southern Rhodesia. Here opportunity abounds for British companies to set up branch factories, for young men with some specialised knowledge to find

careers. Engineers, industrial chemists, and agricultural scientists are particularly needed. A third article is more exclusively chemical in nature; it describes post-war progress in the chemical control of pests and weeds in colonial agriculture. It is pointed out that the colonial demand for DDT and BHC, copper and sulphur fungicides, and selective weedkillers is greater than Britain can actually supply. This is mentioned as a sign of colonial progress; but this country must make sure that the gap does not grow and become a sign of British weakness.

Penicillin and Cheese

A SIDELIGHT on penicillin in the dairy industry is both a tribute to the great bactericidal power of this substance and a flaw in one of its outstandingly successful applications. Penicillin is increasingly used in the treatment of mastitis and other inflammatory conditions of the dairy cow's udders; as a new weapon of veterinary science it has proved exceedingly valuable. But the small amounts of penicillin that pass on into the milk inhibit the cheese-making bacteria when such milk reaches the cheese factory. It requires no more than 0.1 units of penicillin in a millilitre of milk to affect curd formation. Although the milk used for cheese-making is generally mixed, it would not require a high proportion to have come from penicillin-treated cows for a vat of milk to become inconvertible to cheese. And it is likely that several cows and not just one cow in a herd will suffer from mastitis if this ailment occurs at all. This effect of penicillin has been observed in the United States, Sweden, and New Zealand. It seems to be the general conclusion of investigators that milk from penicillin-treated cows should not be mixed with other milk destined for cheese-making.

Acetylene Works Fire

Nitrogen Used to Cool Down Plant

PROBLEMS which had to be overcome when dealing with a fire which occurred in a dissolved acetylene factory of the Saturn Oxygen Co., Ltd., Pallion Trading Estate, Sunderland, on 21 February, are outlined in the report made by the Sunderland County Borough Fire Brigade.

An explosion was reported at 6.17 p.m. and on arrival of the appliances flames were noted coming from a bell-mouthed hopper on a gallery 25 ft. above ground level. This hopper provided the means of charging a plant with calcium carbide, and a closed chamber below had already been so charged. A drum was being emptied into the upper hopper when the explosion took place. The carbide was glowing red hot as was the metal-work of the hopper.

Use of CO_2 on this hopper had no appreciable effect. An attempt was made to remove the glowing calcium carbide by scoops in the hope that the temperature might be lowered.

While this was going on, it was decided that, as the use of CO_2 would involve opening up the plant to atmosphere with the possible consequence of disruptive explosion, the best method was to dilute the acetylene being continually generated and cool down the top of the hopper by feeding nitrogen upwards through the plant.

Nitrogen was available from the nearby oxygen factory, and as the first 150 cu. ft. cylinder was being coupled a further explosion occurred. Still another explosion followed, and the danger of operating from within the plant became more apparent. Operations were therefore continued from without the generator house.

Longer improvised feed lines were necessary and while these were being coupled up, explosions of increasing severity took place.

On coupling being completed, nitrogen was fed in very gently, and after a while the most severe explosion in a sequence of 16 occurred, and proved to be the last. The contents of two cylinders (each 150 cu. ft.), were allowed to trickle through the plant, and an investigation of the hopper in the gallery was then made. This was found to be considerably reduced in temperature and the calcium carbide now black.

The cause of the fire appeared to be a spark struck during charging operations igniting either calcium carbide dust or acetylene gas.

Continued generation of acetylene after the plant was shut down was probably caused by the fact that each upward blast would be succeeded by a partial vacuum in the chamber charged with carbide, and either moisture or saturated air would be drawn from the water tank below.

Drying of Dyed Textile Fibres

Difficulties Imposed by Heat Sensitivity

PROBLEMS of drying techniques, particularly those involving elevated temperatures, which can introduce serious difficulties with dyed materials, were discussed by R. W. Speke, B.Sc., Imperial Chemical Industries, Ltd., Dyehouse Laboratories, Manchester, in a paper presented to the North-Western Section of the Institute of Fuel on 6 March at the Engineers' Club, Manchester.

The paper, entitled 'Drying and Textile Dyestuffs,' was contributed at the invitation of the council, to the symposium under the general heading 'A Study of Drying,' which is being held during the 1950-51 session.

Conventional dyeing processes involve the transfer of dyestuff from aqueous solution or suspension to a textile fibre, other dyestuff carriers than water being only infrequently used. Drying after dyeing is therefore a matter of removing surplus water from the textile material.

The method of achieving this must be largely determined by the nature of the dyestuff and of the substrate, quite apart from the more obvious manipulative considerations, such as the form of the textile material and the effect of the mechanical treatment during drying upon the finish and handle of textile fabrics.

Two of the more important aspects of drying from the dyer's point of view are the 'sweating,' or migration, during drying of dyestuffs of low affinity for the fibre and the heat sensitivity of dyed textile fibres.

Dangers of Over-Drying

Practical significance of the former property is that an initially uniform dyeing can be rendered unlevel by faulty drying, while in the latter case over-drying can, with certain dyestuffs, produce entirely anomalous shades, which complicates the process of matching to shade.

Mechanism of the migration of solvents and solutes during the drying of textile materials has been investigated by J. M. Preston and J. C. Chen ('Some Aspects of the Drying and Heating of Textiles,' part 3, *J. Soc. Dyers and Colourists*, 1948, *64*, 60). They concluded that the solvent (water) moves as a liquid towards the source of heat energy, finally reaching a point where it becomes vaporised and deposits the solute (dyestuff). Dry fibres at the evaporating surface then attract more liquid by capillary action, and the process of vaporisation and deposition of solute is repeated.

If the conditions of drying are such that evaporation of water can take place freely and uniformly from the surface of each individual fibre, only a very limited migration of dyestuff can take place during drying. Where, however, a large mass of textile material is to be dried and the effective evaporating surface is small, drying difficulties are frequently encountered with dyestuffs of low wet-fastness properties.

Must be Water Soluble

For a dyestuff to change its location during drying it must be capable of removal from the fibre by water alone. If no dyestuff is present in the aqueous phase there will be no visible deposit at the evaporating surface. In practice, therefore, sweating is not encountered with cellulosic fibres dyed with vat dyestuffs (after fixation) or with azoic combinations (after coupling), as dyestuffs of these types cannot be removed from the fibre even by prolonged extraction with boiling water. On the other hand, with the same substrate, direct dyestuffs, uncoupled Brenthols or Naphthols, undeveloped Indigosol or Soledon dyestuffs and pigment vat dyestuffs are all very liable to this defect.

Practically speaking, trouble is never encountered with dyestuff migration in the drying of wool. Even with level-dyeing acid dyestuffs, which cannot be regarded as being exceptionally fast to wet treatments, very little desorption of dyestuff takes place on extraction with boiling water, provided that the acid absorbed by the fibre during dyeing has not been neutralised.

Another aspect of dyestuff migration during drying is that of the sublimation of dispersed acetate-rayon dyestuffs. With few exceptions these dyestuffs are amino-azo and amino-anthraquinone derivatives, insoluble in water and, in certain instances, possessed of the property of sublimation, that is, the solid vaporises without the intermediate formation of liquid. It is therefore possible,

when drying acetate rayon or nylon dyed with these dyestuffs for dyestuff sublimation to take place at elevated temperatures, with a consequent change in shade of the dyeing and a staining of any adjacent white material.

The advent of high-temperature post-boarding techniques (that is a combined drying and setting operation for nylon hosiery) provides ideal conditions for the sublimation of dispersed dyestuffs. To give an indication of the ease with which individual dispersed dyestuffs migrate under heat treatments, they are tested by an arbitrary method, in which dyed fabric is heated in contact with white material for five hours at 120° C. (248° F.). The effect of this treatment on the shade of the dyeing is then assessed, together with the staining of the adjacent white material.

Details of the tendency of the individual dyestuffs to sublime can thus be obtained by reference to technical publications on the various products concerned.

Beyond dyestuff selection little can be achieved towards minimising sublimation of dispersed dyestuffs when drying is being carried out at elevated temperatures. Use of the water-soluble Solacet dyestuffs on both acetate rayon and nylon, however, gives dyeings essentially free from this defect.

Undergo a Shade Change

The majority of dyed textile fibres, when subjected to heat treatments in the dry state, undergo a shade change the magnitude of which varies with the individual dyestuffs, the nature of the substrate and the time and temperature of heat treatment. When the heat source is removed, reversion to the original shade takes place; with certain dyestuffs this is a rapid process while in others it is slow. In practice the use of dyestuffs which are markedly changed in shade by heat treatments, and which show a slow reversion to their true shade, involves certain complications.

With such dyestuffs the dyers may be entirely misled as to the ultimate shade of a dyeing, if, during 'patterning off,' the material is over-dried, for example, by ironing with a very hot iron. Alternatively, bulk materials which have been dried for too long at an elevated temperature may give the impression of being entirely off-shade. The dyeing may also appear to be unevenly dyed owing to irregular contact between the overheated fibre and a moist atmosphere, which has the effect of speeding-up in localised areas reversion to the true shade.

Fundamental reasons for the changes in shade of dyed textile fibres with dry heat have not been elucidated. Possibly, however, they are a function of changes in the physical state of the fibre itself—changes occasioned by the complete or partial removal of the normal regain moisture. Support for this hypothesis is gained from the fact that contact with water, either in liquid or vapour form, promotes the rate of reversion to the true shade.

Chemical Changes Possible

Heat treatments may also change the chemical nature of the dyestuff, for instance, by removing combined water molecules. Alternatively, either the location of the dyestuff in the fibre structure or its physical state may be changed by heat treatment, although in such instances it might be anticipated that reversion to the original shade would not take place.

In order to assist dyestuff users, an indication of the relative heat sensitivity of individual dyestuffs is determined by an arbitrary test, to enable individual products to be rated for their 'fastness to hot pressing.' ('Fastness Assessment of Textile Dyestuffs,' manual published by I.C.I., Ltd., 1946).

The test involves heating a portion of the dried, conditioned dyeing for 10 seconds at a temperature varying according to the nature of the substrate, for example, cotton at 200° C. (392° F.), viscose rayon at 140° C. (284° F.), wool, acetate rayon and silk at 120 °C. (248° F.). The change in shade occasioned by the heat treatment is then assessed and the time noted for complete reversion to the original shade.

According to the speed of reconversion the dyestuff is then rated on a 1 to 5 scale, in the following manner:—

Grade 1. Slowly, greater than 20 minutes; 2. Fairly slowly, 10 to 20 minutes; 3. Quickly, 5 to 10 minutes; 4. Very quickly, up to 5 minutes; 5. Unaffected in shade.

Thus, for example, Durazol Orange 4R dyed on viscose rayon is typical of a heat-sensitive dyestuff, as it becomes much yellower under the specified test conditions and reversion to the true shade takes over 20 minutes. Its fastness to hot pressing

is, therefore, quoted as 'Much yellower, 1.'

All the main dyestuff classes contain heat-sensitive members. Direct cotton, vat and azoic dyestuffs on cellulosic fibres are all liable to this defect. Many orange and violet direct cotton colours are susceptible to persistent heat changes. Of the vat dyestuffs it is among the violet, navy blues and browns that the majority of heat-sensitive colours, showing slow reversion to the true shade, are to be found. Azoic combinations, particularly those based on Brenthols AN and FO, are susceptible to heat changes. Furthermore, with this group of dyestuffs there is a tendency for the shade change to be permanent.

Dispersed dyestuffs, on both acetate rayon and nylon, do not undergo marked shade changes when subjected to dry heat treatments, and, where small changes are apparent, reversion to the true shade takes place rapidly. When comparing the heat sensitivity of Duranol and Dispersol dyestuffs on acetate rayon and nylon, it was found that the direction of change of shade was the same for any one dyestuff on the two fibres, but that the recovery from change was quicker on the nylon fibre and the magnitude of the change less.

Wool dyed with acid, premetallised and chrome dyestuffs are liable to undergo shade changes when subjected to dry heat treatments. The premetallised Ultralan range contains a high proportion of heat-sensitive dyestuffs although the chrome dyestuffs, which are metallised after application to the fibre, are comparatively free from this defect. A greater number of heat-sensitive dyestuffs are encountered among the acid-milling dyestuffs than among the level-dyeing acid types.

To avoid difficulties due to heat sensitivity the drying process must be controlled to prevent over-drying, which results from the subjection of the textile fabric to dry heat at elevated temperatures. Such control is frequently an impossibility when drying large quantities of textile materials, owing to differences in drying rate throughout the mass.

Where undesirable shade changes have been brought about by heat treatments one remedy is to allow the material to 'age,' that is, come into contact with a humid atmosphere. Prolonged times, of the order of days, are occasionally required before 'ageing' to the true shade is completed. Alternatively, a mechanical arrangement may be employed, whereby the fabric is passed over a steam slot to speed up the rate of moisture absorption.

In conclusion, it may be stated that a dyed textile fibre generally calls for more care during drying than an undyed one. If it were economically possible to dye all cellulosic fibres with fast dyestuffs, for example, either vat or azoic dyestuffs, this difficulty would not be encountered, but the attainment of this ideal is very much in the future, although a general trend in this direction is already apparent.

Drying difficulties imposed by the heat sensitivity of dyed textile fibres will, however, persist until drying processes can be sufficiently controlled.

Misplaced Credit

WHEN the Hungerford brewery lion which now guards the Festival of Britain site first arrived at the South Bank, the wrought ironwork underneath the Coade stone was found to be heavily rusted.

Mr. Peter Morton, sculptor and adviser on historical monuments to the L.C.C., called in Mr. Frank Bricknell, one of Jenolite's leading rust and corrosion experts. It was he, who after examining the damage caused by the rust, was the first to discover the trap-door which led to the finding of the much-publicised bottle.

A workman was asked to open the trap, and it was he who was afterwards given credit for the discovery, despite the fact that Mr. Bricknell personally took the bottle and handed it himself to Mr. Farrer, keeper of historic records at County Hall.

Rust and corrosion cause serious damage to many historic monuments and the Jenolite process has been instrumental in helping to preserve many of them.

Wolfram in S. Rhodesia

Appreciable quantities of scheelite (one of the tungsten ores) have been demarcated at the Sunace property of Falcon Mines, it was revealed in Bulawayo last week. Additional plant has already been installed and recovery and concentration of wolfram from the ores is expected to begin shortly.

Atom School to Open

Instructions on Uses of By-Products

AN atomic energy school to teach workers in industrial and medical laboratories how to use radioactive materials is to be set up at the Atomic Energy Research Establishment at Harwell. The first course, lasting six weeks, and costing £40, begins on 2 April, and will be in charge of Dr. J. E. Johnston, of Harwell's Isotope Division. Thereafter they will last twelve weeks.

The school has been set up, states the Ministry of Supply, because the rapid increase in the use of British radio-isotopes has led to a widespread demand for further education in their uses. Both medical and industrial people wish to learn what can be done with radio-isotopes and what apparatus and methods are necessary to deal with radioactive materials. In addition many organisations wish to apply radio-isotopes to a specific purpose, and need training facilities in these techniques.

Exaggerated Ideas Held

So much publicity has been given to the elaborate arrangements at Harwell and Amersham that many prospective users have an exaggerated idea of the equipment needed to use radioactive materials as tracer substances. The school will show how comparatively simple equipment and lay-outs can be used, if proper precautions are taken. It will also give students of graduate level detailed instruction in the fundamental, practical and theoretical problems encountered when radioactive materials are used in the quantities employed in a normal laboratory. They will learn methods of handling radioactive materials as they are received from Harwell, and also the difference between isotopes of various substances. This will help to guard against the ordering of unsuitable 'substances by industrial and medical users. They will be taught how to measure radioactivity with a Geiger counter and scaler, and how to use scintillation counters, ionisation chambers and photographic methods for radiography and radioautography. The experiments they will carry out will give them ample experience of the methods of radiochemistry.

The school will also give them a broad outline of the principles of nuclear physics, the principles of the electronic circuits used in measurement and the hazards and biological effects of radioactive materials.

Sulphur Exports Planned

Canadian Firm to Build Big Plant

DEVELOPMENT of an export market in sulphur as well as supplying the demand in Canada is planned by Noranda Mines, Ltd., which has in view construction of a $4,000,000 plant to produce 150 tons daily, of which one-third will be elemental sulphur and the remainder sulphuric acid. Site of the plant is still undecided, but Hamilton, Ontario, is favoured by some officials. The plant will in addition to sulphur, produce 200 tons of sinter iron daily.

Exports to U.S.A. Possible

'There is no reason, if our process proves successful on a commercial scale, why we can't ultimately supply a good part of the northern U.S. Great Lakes market,' a Noranda official said. 'This would mean building a number of sulphur plants as close as possible to markets.'

Noranda engineers have been working almost ten years now on sulphur processing problems and have developed a new process to handle Noranda's pyrites raw materials and to process sulphur, sulphuric acid and sinter iron.

Canada consumes 200,000 tons of sulphur annually with the pulp and paper industry the major user. All of this is imported from the U.S. and because of a seriously tightening supply situation there Canadian importers are having to take a 20 per cent cut in supplies this year.

Development Urgent and Attractive

This, plus a recent price increase of $4 a ton, has made development of a Canadian source urgent and attractive. Although initial production rate of the mill will not make up for the 20 per cent cut in imports, it is probable that the production rate will be raised as soon as the new process has satisfactorily proved itself.

Noranda has sufficient reserves of pyritic ores on its lower levels to justify production of some one million tons of pyrites a year for around 40 years.

Although there is a considerable flexibility in operations permitting varying stress to be placed on the three finished products —elemental sulphur, sulphuric acid, sinter iron—production in the first plant is roughly on the basis of one ton of sulphur for every two tons of pyrites.

Synthetic Blood Substitutes

By Leon D. Gruberg

FOLLOWING up the basic research initiated originally in Sweden and Germany, American chemists have succeeded in making marked progress toward providing a suitable synthetic blood substitute. On the one hand, chemists of the General Aniline and Film Corporation, New York, say that they are ready to begin large-scale production of PVP (polyvinylpyrrolidone)* an I.G. Farben developed synthetic blood substitute which was successfully used by Germany during the war. On the other hand, Commercial Solvents Corporation, also of New York, taking its lead from Swedish research, is prepared to undertake commercial production of dextran, a sugar-derived synthetic plasma, and is now spending $200,000 in the expansion of a pilot plant for further development of the product. Both of these blood substitutes are of immense potential importance in the event of an enemy attack on highly populated cities. Both can be made at considerably less cost than the cost of obtaining blood or blood derivatives.

The successful synthesis of PVP marks another step forward in the relatively new field of acetylene chemistry. American chemists have known for years that acetylene was an extremely useful and versatile chemical, but to utilise its versatility meant working with it at high temperatures and under high pressures. Under these conditions it was recognised as being too dangerous, and as such was left strictly alone by the chemical industry.

Meanwhile, in Germany, Dr. J. Walter Reppe, a leading I.G. Farben chemist, successfully evolved techniques for carrying out acetylene reactions under high pressure. This was the first step in opening up a new field of chemistry. About three years ago when high pressure acetylene chemistry became a commercial reality in the United States, top ranking chemists hailed the development as a revolutionary advance. They compared it to the introduction in the 1920's of high pressure hydrogenation of nitrogen to give ammonia by the Haber process, which showed the chemical industry how to operate under pressures that were far above atmospheric.

Acetylene is a highly inflammable and colourless gas and Dr. Reppe discovered that it could be handled under pressure and at elevated temperatures if the gas stream is divided into smaller flowing streams. His technique for the safe use of acetylene consists of two methods, one involving the dilution of the chemical with an inert gas, and the other in which acetylene is reacted in small-bore equipment providing a minimum of free space for gases to collect. Acetylene chemistry was indeed vital to Germany during the war, enabling the nation to produce strategic materials such as synthetic rubber, synthetic fibres, pharmaceuticals, synthetic blood plasma, and other products.

Through a series of patent acquisitions, General Aniline and Film Corporation obtained and made improvements on the Reppe techniques. In 1949 the company placed in operation the first high-pressure acetylene plant in the U.S.A. at Grasselli, New Jersey, where acetylene derivatives, including

In charge of the manufacture of PVP is Dr. Hans Beller who is shown with a sample of the blood substitute in the laboratory of the Grasselli plant

* Editor's note: L. Light & Co., Ltd., of Colnbrook, Bucks., can supply from stock, research quantities of P.V.P.

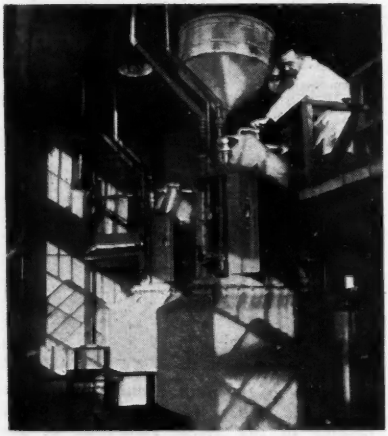
PVP, have since been made on a semi-commercial basis. Most of the plant's products, new to American chemists, are now either in industrial use or are being evaluated for a variety of commercial possibilities in laboratories throughout the country.

PVP is a white powder which, when mixed with water or many organic solvents, dissolves to a clear solution. The viscosity of the solution depends on the degree of polymerisation of the product. Chemically, it is one of a group of soluble poly-n-vinyl-lactones. In powder form this blood substitute can be stored indefinitely; and when prepared as a water solution it is stable over long periods of time.

The PVP chosen for the preparation of the original 2.5 per cent solution for plasma tests had a molecular weight range of 5,000 to 50,000, and it is considered that an average weight of 25,000 is most desirable for plasma preparations.

Early and as yet inconclusive reports by American clinics and pharmaceutical laboratories where investigations of plasma substitutes have been carried on indicate that the PVP compound holds great promise and may even have some advantages over natural blood plasma.

A number of important advantages are claimed for both PVP and dextran. These substitutes have, of course, no protein like the natural product, and thus slightly lower the protein content of the blood.



Making acetylene from calcium carbide is a first step in the production of PVP

The primary intended use for PVP is to restore circulation and maintain blood pressure, both of which may be seriously affected in a person badly burned or injured, or it may be applied in modern shock treatment. Injected intravenously, the blood substitute will maintain circulation for twelve to twenty-four hours, after which a new dose may be administered. The average recommended therapeutic dose, according to General Aniline officials, is a 3.5 per cent PVP solution of 500 to 1,500 cc. for adults in ordinary cases and up to 6 litres in extreme cases. For infants and small children, the average dose is 25 cc. per/kg of body weight, usually repeated twice daily.

Although this much is known of the applications and potentialities of blood substitutes, medical knowledge is still far from complete. As part of the testing programme now in progress with PVP, radioactive samples containing carbon 14 are being investigated at the atomic Brookhaven National Laboratories at Upton, Long Island, New York.

Apart from its potentialities as a blood substitute, PVP may be the beginning of the development of a remarkably effective and safe virus killer. The preparation, it has been found, can be combined with iodine, long known as man's most powerful germicide over a wide spectrum, making the highly toxic element safe even for internal use. In combination with iodine, PVP acts as a detoxifier without destroying its high efficiency as a virucide or germicide.

Extension Work Carried Out

Perhaps the man who knows more about PVP as a detoxifier than anybody else is Dr. Herman A. Shelanski, a toxicologist and General Aniline consultant who conducted extensive tests with PVP-iodine at the Philadelphia General Hospital, Philadelphia, Pa. Work has been carried on there for more than 18 months, during which successful results have been obtained—using PVP-iodine—in the treatment of more than 100 skin infection cases of varying severity; cases which had failed to respond to conventional treatment. Systemic infections such as grippe and colds have also shown rapid, and marked improvement under the PVP-iodine treatment. No harmful side effects were observed in any of the cases.

Besides detoxifying the iodine, PVP appears to give it a longer duration of effect.

This 'extender' effect had been noted with other substances when combined with PVP. Dr. Shelanski quoted cases where the use of insulin was reduced from three injections a day to one injection every other day when put in solution with PVP.

'Few substances, it seems safe to say, have an indicated usefulness in so many and diverse applications,' he said, pointing out that encouraging results have been obtained with PVP in the treatment of diabetes, venereal disease, burn cases and others where PVP was used either alone or to extend the effect of penicillin, insulin and cortisone.

Dr. Shelanski said that he was satisfied that PVP is the long-sought substance the medical profession has needed to get the full benefit of iodine. However, he added, 'it will require more clinical study than we've given it, to satisfy others, and properly so.' Summarising his work with PVP-iodine, he declared that:—

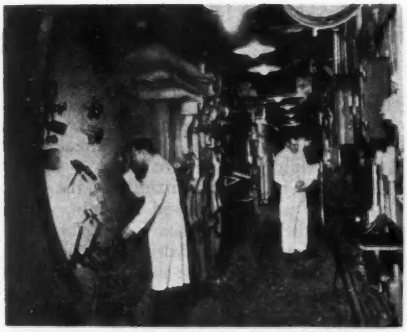
1. PVP-iodine was more effective than iodine alone in treating bacterial infections because of the longer duration of effect;
2. PVP-iodine is virtually non-irritating and therefore the scope of its use is much greater. It can be used on all tissues, internal and external, without danger of burn or intense irritation;
3. The toxicity of the iodine in PVP-iodine has been greatly diminished so that it may be given orally or intravenously in therapeutic doses without undesirable side effects. The maximum limit has not yet been established for intravenous use in human beings;
4. No iodine sensitivity produced by the PVP-iodine was noted in the entire series of cases and proven cases of iodine-sensitive people did not react to PVP-iodine.

Thus, with the development of PVP-iodine, new fields of research in the use of iodine are being opened up. Meanwhile, General Aniline research in the matter is continuing on an accelerated scale.

Now well out of the pilot stage, commercial facilities for the production of polyvinyl pyrrolidone were recently placed in operation by General Aniline at its Grasselli works, New Jersey. Although the company is at present producing only 1,000 lb. per month, enough to make 25,000 units in terms of plasma measure, this capacity is being increased fifteen-fold to a quantity sufficient for 375,000 plasma units a month by the beginning of May, while plans are underway to increase capacity to 1,500,000 units a month by January next year. Erection of a plant for really large-scale production could be completed in ten months, if the Government so desired.

Equally important as a blood substitute from the medical point of view is a sugar derivative called dextran, on which since June, 1949, the Commercial Solvents Corporation has been carrying out laboratory research and development work in the U.S.A.

Dextran is a fermentation product. It is derived from the fermentation of sucrose by



Remote control of processes in the manufacture of PVP and other high pressure acetylene products is carried on in this explosion-proof corridor

The apparatus used in the preparation of radioactive acetylene (from which PVP is derived) by the hydrolysis of radioactive barium carbide

an organism called *Leuconostoc mesenteroides*, and refined by acid hydrolysis. The clinical importance of dextran is dependent upon its composition with molecules of large size which for this reason hold fluid within the circulatory system. Thus it can act to replace fluid which has been lost in numerous clinical conditions following trauma.

The problem in producing dextran is to make a preparation in which the majority of the material is of uniform molecular size, so it will be compatible with the blood circulation system. Commercial Solvents' chemists believe that this has now been achieved, and in the numerous cases in which dextran has been used there have been no instances of unfavourable reactions.

Plasma Volume Extender

Impressive results with the use of dextran on human patients have been reported by a number of clinicians, notably Dr. Walter V. Bloom and Dr. James V. Warren, both of Emory University's School of Medicine at Atlanta, Georgia. In addition to research at the university, work with dextran has been carried out at the Grady Memorial Hospital, Atlanta, and in the Research Division of the Lawson Veterans' Administration Hospital, Atlanta. Using dextran in place of blood plasma in treating 47 patients suffering from loss of blood and shock, both doctors report that the blood substitute successfully served the purpose of maintaining fluid within blood vessels at normal levels. No undesirable side effects were noted, except for anaemia in some cases, due to loss of blood cells. Like other blood substitutes, dextran does not contain blood cell material and therefore cannot replace them.

There were at least two major points to be determined before the usefulness of a plasma volume extender,' a term Dr. Bloom prefers to ' blood substitute,' could be established. The first was that the material would expand and maintain the plasma volume for an adequate period of time; and the second, that the plasma volume extender produced no unfavourable reactions in the normal functions of the body.

One hundred convalescing patients were injected with one to four pints of dextran and studies were carried out on the functions of the heart, lungs, kidneys, liver, blood, stomach and intestines. No impairment of function was observed. In all cases there was an increase in the fluid volume in the circulation. This increase was maintained for as long as six hours.

As much as three-quarters of a pound of dextran, Dr. Bloom said, has been injected without any undesirable effect. Many patients have received repeated injections without reaction. In each instance the dextran has proved an effective way to hold fluid in the circulation.

Like others who are wary of being too definite about the efficacy of blood substitutes, Dr. Bloom says: ' It must be emphasised that this (dextran) is not a blood or plasma substitute. It has but one function, which is to hold sufficient fluid in the blood vessels to maintain proper circulation. However, this function is the most important factor in the treatment of shock.'

Although Commercial Solvents has gone further in developing productive facilities than others, it is by no means the only firm in the field. Industrial grade dextran—used for viscosity and moisture control—has been produced for a number of years by Refined Syrups and Sugars, Inc., which expects to begin production of a pharmaceutical grade of dextran in a new plant within the next two months.

Other firms are similarly investigating the commercial possibilities of dextran, while some distillery firms, notably Schenley Distillers Corporation, are gearing themselves to produce PVP and other blood substitutes.

Dextran, a biosynthetic polysaccharide obtained by the action of *Leuconostoc Mesenteroides* on sucrose (table sugar), is composed of a number of units of glucose (blood sugar) which are joined together in a long chain.

Breaking Down the Chain

The molecules of dextran as obtained in the final step of the biosynthesis are too large for safe use in man. It then must be subjected to a process which breaks the material into glucose chains of a smaller length which have approximately the same molecular weight as blood albumin. The reduction in molecular size is brought about by a process of acid hydrolysis. Since the linkages between glucose units are broken in a more or less random fashion, the mixture of products obtained also contains some molecules which are too small and some which are too large for clinical usefulness.

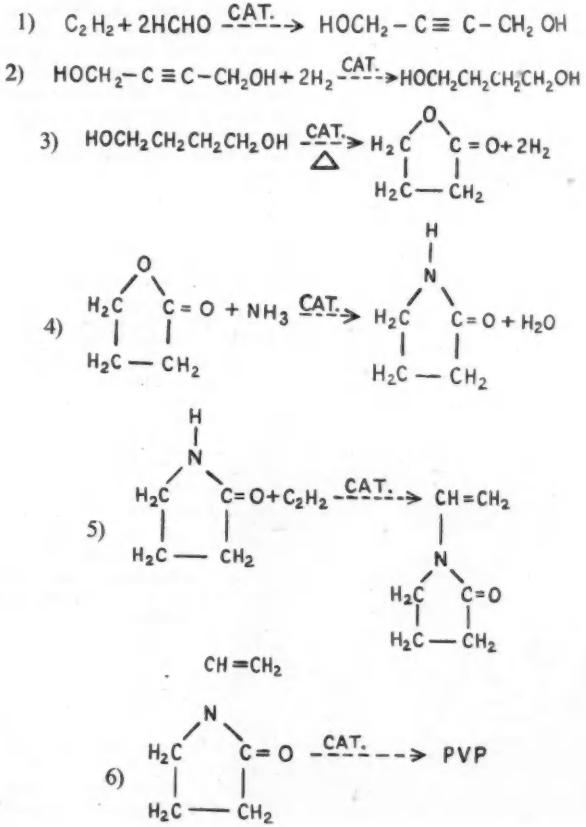
Separation of molecules of the right size is then achieved by fractional precipi-

tation with alcohol. This dextran product must then be further purified and is subjected to safety tests which determine its suitability for clinical use. Next it is put into solution with water containing salt in the same concentration as is found in blood plasma. This solution is filtered, bottled, and sterilised by autoclaving. Final control tests are then carried out on each lot of clinical dextran. Nineteen separate chemical and biological assays are performed and the results of these tests determine whether or not the lot is released for injection into humans.

In dextran, the glucose molecules are joined together by the same two types of chemical linkages which are found in glycogen (body starch). However, in dextran there is a greater proportion of the chemical linkages present which are somewhat resistant to the action of body enzymes.

Experimental evidence has been obtained indicating that various strains of *Leuconostoc mesenteroides* can produce glucose polymers (dextran) which are not identical with each other, but differ in the degree of branching. Commercial Solvents dextran has been used successfully in a large number of cases without undesirable side effects and appears to belong to the class of dextrans in which the degree of branching is at a minimum.

The manufacture of PVP proceeds by the following equations:—


1) $C_2H_2 + 2HCHO \xrightarrow{CAT.} HOCH_2-C\equiv C-CH_2OH$
2) $HOCH_2-C\equiv C-CH_2OH + 2H_2 \xrightarrow{CAT.} HOCH_2CH_2CH_2CH_2OH$
3) $HOCH_2CH_2CH_2CH_2OH \xrightarrow[\Delta]{CAT.} H_2C(CO)CH_2 + 2H_2$
4) $H_2C(CO)CH_2 + NH_3 \xrightarrow{CAT.} H_2C(NH)CH_2 + H_2O$
5) $H_2C(NH)CH_2 + C_2H_2 \xrightarrow{CAT.} H_2C(N{-}CH{=}CH_2)CH_2$
6) $H_2C(N{-}CH{=}CH_2)CH_2 \xrightarrow{CAT.} PVP$

Carbon Black Factory

American Plans Causing Concern

THE report that one or two large American firms contemplated the erection of a factory for carbon black manufacture in the Ruhr district on the Rhine-Herne canal is causing some concern in Germany, in view of similar developments in Great Britain in conjunction with American interests.

Recent Events Reviewed

Dr. Kurt Giese, of Dusseldorf, reviews recent events in the carbon black industry, with this as a starting point. He thinks that relatively little is known, even in technical circles, of the true significance of carbon black, or of the actual processes involved in its manufacture. In the first place it is only recently with the aid of one of the few electron microscopes available in Germany that the true structure of this material as graphitic-crystalline rather than truly amorphous has been realised. Moreover there is a wide range of different kinds of black varying very widely in properties, particle size, dispersion, density, colour, etc. Especially important is the varying nature of its behaviour in the vulcanisation of rubber-carbon mixtures. (*Chem. Industrie*, 1951, *3* (2), 58-60).

While formerly it was customary to classify the various blacks according to origin or method of production, it is now more usual to designate them according to uses, of which there are many. About 100 of these have been listed in the U.S.A.

Several attempts have been made in Germany to produce active carbon black, including those of the I.G., BASF (Badische Anilin and Soda Fab.), and the Krupp-Conti process, largely under the stimulus of the pre-war autarchy or self-sufficiency policy. Another leading German pioneer was Degussa (Deutsche Gold- und Silberscheide Anstalt, etc) who had a large plant at Kalscheuren bei Köln, and used the method of carbonising aromatic hydrocarbons, preferably naphthalene. Shortly before the war another firm began production, namely, the Russwerke Dortmund GmbH, now known as the Deutsche Gasrusswerke GmbH, in which Degussa and other German firms were interested, and who used not only naphthalene but also anthracene residues, the latter giving much better yields of black. A plant was also erected at Gleiwitz/O.S. during the war, using tar oils as raw material. This Upper Silesian factory was dismantled by the Russians and re-erected in the Donetz district. Both the West German factories suffered considerable war damage and were only properly refitted about the beginning of 1950, but with considerable improvements and more modern plant.

Some recent American and British developments and new processes are also noted briefly by the author, together with total world production figures. Total rubber consumption for 1950 was estimated at nearly 2,000,000 tons, and for carbon black about 700,000 tons, of which the U.S.A. probably accounted for at least 600,000 tons. In 1949, the English rubber industry imported more than 28,000 tons of black. It was hoped that the two new carbon black plants in Great Britain would dispense with these imports. Total European production, however, would still be no more than about 60,000 tons, even then, including new French plants in Gasfeld St. Marcet where natural gas is available, and in the Saar where methane or mine gas is said to be plentiful.

In Germany it is thought that, after providing for the needs of the home rubber industry and other demands for carbon black, some 10,00 tons might be available for export.

Canadian Cellulose Plant

THE Celanese Corporation of America will shortly start construction of a large petrochemical and cellulose-acetate plant near Edmonton in Canada, it has been announced.

A new celanese affiliate named Canadian Chemical Co., Ltd., has been formed in Alberta to build and operate the plant on a site already selected.

Tapping the natural gas resources of Alberta's petroleum fields, the new company will manufacture many basic organic chemicals never before produced in Canada. The company will utilise the celanese process of direct oxidation of petroleum hydrocarbons.

Acetic acid produced in the new plant will be combined with wood pulp from the Columbia Cellulose Co., Ltd., plant at Prince Rupert, B.C., to manufacture cellulose acetate, primary raw material for acetate yarns and plastics. Columbia Cellulose is also an affiliate of the Celanese Corporation.

Higher Alkyl Chloride Industry

Important Germicidal Uses for Surface-Active Compounds

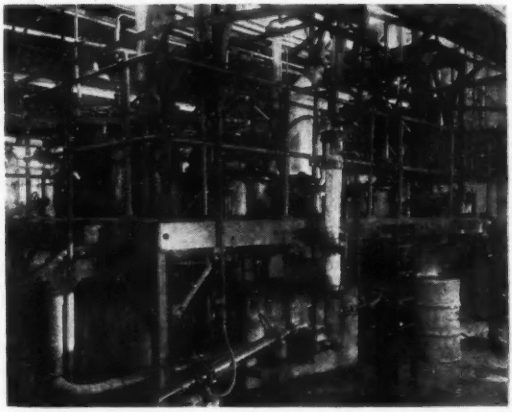
AN important branch of the British chemical industry which has been developed since the war, is the production of surface-active compounds based on the higher alkyl chlorides. By making available to British industry a range of valuable chemicals formerly obtainable only from the United States, this new industry represents an important contribution to the national resources.

The company responsible for these developments is Leda Chemicals, Ltd., which was formed in 1943. It started operations in modest premises situated in Archway Road, Ponders End, Middlesex, where small quantities of various organic chemicals were produced. Research included pioneer work on solubilisation, as a result of which a transparent emulsion of DDT in water was developed and produced in very large quantities. During this period a market survey was undertaken both at home and abroad to determine the directions in which the company's activities could most usefully be expanded.

Largely as a result of this work the company became interested in various surface-active compounds, especially those of a cationic type, and partly because of the difficulty of obtaining supplies the directors decided to start producing their own requirements of these chemicals. Potential users and importers were subsequently referred to the company by the Board of Trade and other Government bodies. Close contact was maintained with the Board of Trade, who encouraged the firm to develop the production of chemicals which had to be imported from hard currency countries, and were consequently difficult to obtain.

Against this background it became evident that the company was destined to concentrate much of its attention on the field of higher alkyl chlorides and that larger premises would be required. In 1946 the works was therefore transferred to Wharf Road, Ponders End, and during the past four years considerable progress has been achieved in establishing an entirely new industry for Britain.

No major difficulties were presented by the chemicals which could be produced with normal types of plant and equipment, but in the case of the higher alkyl chlorides many formidable obstacles had to be overcome. The process involved chlorination of the higher fatty alcohols, which had to be conducted at temperatures up to 200°C. Some of the processes had to be carried out under pressure, and even standard glass-lined equipment was unable to stand up to these severe conditions. The company was therefore obliged to have its own special plant designed and fabricated with the



A section of the distillation house showing some of the equipment used in distilling some of the higher alkyl chlorides

assistance of manufacturers of glass-lined equipment. Valuable help was received from Quickfit & Quartz, Ltd., who collaborated closely in the early stages.

Must Withstand Acids

Valves and gaskets, as well as instruments such as temperature and pressure gauges, all had to be produced from materials capable of withstanding acids at high temperatures and pressures. Special vacuum pumps had to be used which were capable of distilling the products in the presence of moist hydrochloric acid gas. Special alloys had to be used for cocks and valves, and fortunately it proved possible to obtain from the United States small supplies of 'Teflon'—the only material the company found capable of standing up to these conditions unaffected. These exceptional corrosion conditions made protection necessary for steelwork, buildings and foundations, and great difficulties were also encountered in handling materials such as thionyl chloride and silicon tetrachloride.

Having successfully developed the production of higher alkyl chlorides with radicals ranging from octyl (C_8) to stearyl (C_{18}), the company used these compounds as intermediates in the manufacture of the quaternaries, which are now the principal products marketed. Among these chemicals is lauryl pyridinium chloride, which formerly had to be imported. This product is a cream-coloured waxy solid, resembling soap in appearance and in the copious lather produced with water. It is very soluble in water, 62 gms. being dissolved by 100 ml. of hot water, and its solutions have a very low surface tension. It is very soluble in acetone and ethanol and is also soluble in benzene and carbon tetrachloride.

The main use of lauryl pyridinium chloride is in the textile industry to prevent the clogging or incrustation of the spinnerettes in the acid bath used in viscose spinning. This chemical is also used as a fixing agent for direct dyestuffs giving them excellent fastness. Its use greatly softens the handle of cotton or rayon clothes, while its bactericidal action prevents mould growth. It is also employed as a general cationic emulsifying, wetting and dispersion agent in the preparation of industrial emulsions, as a dandruff remover in the toilet industry, and as an anti-static agent in the plastics industry. Very powerful germicidal properties make it an excellent general disinfectant and bactericide in concentrations as low as 200 parts per million.

The company also supplies cetyl pyridinium chloride, which is used to prevent the running of dyes and also to give coarse cotton goods a very soft handle. This material is also used for sanitation purposes, being soluble in water and one of the most powerful germicides known. At concentrations from 1 in 2,000 to 1 in 20,000 it is effective for this purpose in both acid and alkaline conditions ($pH_{2\text{-}10}$). Apart from its use as a general sanitiser, it is used in surgery since it is non-toxic and concentrations as high as 1 in 200 have no harmful effects on the skin. An excellent emulsifying agent, it has been incorporated in insecticide compositions to form oil-in-water emulsions. Because of its power to make normally water-repellent substances adhere in the presence of water, it finds another useful application in coating road surfaces with tar and stones (THE CHEMICAL AGE, 23 September, 1950). The material imparts a positive electrical charge to surfaces in contact with it, so that these surfaces repel particles of dust which normally cling to them. There is accordingly believed to be a great future for it in the field of polishes. It has also been used in the manufacture of gramophone records to prevent the collection of dust due to the static electrical charges built up. This application is proving particularly valuable in connection with the new long-playing polystyrene records.

Food Sanitation Uses

Other products include quaternaries based on substituted amines such as lauryl dimethyl benzyl ammonium chloride. These compounds are used very extensively in the United States for pharmaceutical and general sanitation purposes, especially in disinfecting dairy equipment, brewery equipment, and for food sanitation generally. In fact, it is a legal requirement in several American States that all food establishments, bars, etc., should have this material present in the required concentration in water used for washing up.

The United States Pharmacopoeia have included this material under the title of 'benzalkonium chloride.' This latter is a mixed alkyl dimethyl benzyl ammonium chloride, the alkyl radicals ranging from C_8

to C_{18} with a predominance of C_{12}. The bactericidal and germicidal power of benzalkonium chloride solution is about 60 times as great as that of the best known proprietary disinfectants. The effect is instantaneous, and as little as one part of benzalkonium chloride in 80,000 of water completely inhibits the growth of the tubercle bacillus. Concentrations of less than 1:1,000 are neither toxic nor irritating and can be used for disinfecting combs, brushes, razors and clippers in hairdressing.

Leda Chemicals, Ltd., believe that at present they are the only company outside the United States which is producing this chemical on a commercial scale. They are now supplying British firms with various quaternaries of the higher alkyl chlorides. They are also doing a large and expanding trade with the Continent and the British Commonwealth, and there is a distinct possibility that they may be able to supply Canada and even the United States. Recently cetyl pyridinium chloride was supplied to a hospital ship fitted out in Denmark for use in Korea, this being the only germicide sanctioned for use on board. An important advantage possessed by the material is its portability, since the compound is a solid which can be produced in pellet form for use in first-aid kits, and can be readily dissolved in water.

Future Expansion Planned

The company's future plans are to expand the entire field in which these higher alkyl radicals enter into the composition of organic chemicals. In particular, it is proposed to manufacture commercially the higher alkyl mercaptans used in the synthetic rubber industry, high alkyl amines used in ore flotation and in the textile industry, the higher alkyl nitriles, and various other classes of organic chemicals based on the fact that the higher alkyl chlorides are excellent intermediates for introducing the alkyl radical.

As a result of its experience in the field of textile chemicals, the company is looking into the question of textile fibre impregnation with various compounds to impart new and desirable properties such as water repellance, fire-proofness, increased tensile strength, etc., by using some of these long-chain radicals in conjunction with synthetic resins. A plant has been installed for the production of intermediates for this purpose such as dicyandiamide, which is now being manufactured on a limited commercial scale.

Czech Research Director

The firm has its own chemical engineering staff, fitters, welders, designers, draughtsmen, etc. Research is carried out under the aegis of Dr. Stanislaus Malachta, D.Sc., formerly of Prague University, who is chief research chemist. He has a staff of five research chemists and has been largely responsible for the new processes developed. At the head of the chemical engineering section is Mr. H. Curtis, B.Sc., A.R.I.C., A.M.I.Chem.E., formerly of Mactaggart & Evans, who has been in charge of the design and installation of plant. Mr. Curtis's work has been outstanding in solving the manifold problems associated with the highly corrosive nature of the materials used. Production has been in the hands of the technical director, Mr. Edward Shamash, B.Sc., A.R.I.C., who is the works manager. The fact that the chemists and technicians work very happily together as a team is evident from the enthusiasm and rapidity with which processes have been taken from their first inception in the laboratory to full commercial production.

One of the major factors responsible for the company's success is productivity. All plant is designed with a view to the provision of mechanical handling and automatic controls. A feature of the works is the very small number of employees engaged on production, and this economical use of labour has enabled the company to be very competitive in all world markets. New and improved chemical procedures are constantly beng developed.

The company is now in the process of moving to a new 14-acre site situated at Waltham Cross, where existing and future products will be manufactured under the most modern conditions.

Among the chemicals to be produced at Waltham Cross is a new quaternary ammonium compound based on morpholine, which is being developed in the United States as a combined detergent and bactericide and which possesses powerful deodorising properties. It is also hoped to develop the alkyl derivatives of the silicones by the use of these versatile new materials, the higher alkyl chlorides.

Belgian Sulphur Recovery

Low Sulphur Content of Coal

ACCORDING to Georges Leonet, writing in *L'Ind. Chim. Belge* (1951, *16* (1), pp. 14-21) on Belgian processes for sulphur recovery, Belgian coals are relatively poor in sulphur, their content ranging from 0.8 to 1.3 per cent, or, say, an average of 12 kilos per ton. The author is chemist of the City of Brussels and secretary of the Commission des Etudes Chimiques de l'Association des Gaziers Belges, and he says that although nearly 7,000,000 tons of coal were treated in gas works and cokeries in 1949, little of the sulphur content was recovered; and the reason, strange as it may seem, was largely due to the fact that natural sulphur until recently was being sold in Belgium at such a low price that gas-works or coke sulphur could not be economically recovered. The greater part of the coal was dealt with in cokeries, and only about 44,000 tons at gas-works, properly. Out of 2,930,000 cu. m. of gas produced, about half (1,483,000) was used for heating in the coke ovens, and the remainder for public supply, metallurgical, and synthetic purposes. The total theoretical sulphur content could be 14,650 tons and with a 75 per cent yield, 11,000 tons; but since practically none of the coke oven gas—constituting about half the total source of sulphur—and little or none of that used in the metallurgical industries has ever been desulphurised, the only feasible source would seem to be the gas used for synthetic purposes and part only of the town gas, *i.e.*, a maximum of about 4,000 tons, or say 3,000 tons from a 75 per cent yield. The various methods used, says M. Leonet, are as follows:

Most of the gas-coke-works use the dry method with iron oxide. There are some exceptions. The Société Carbonisation Centrale à Tertre, the City of Brussels coke-works and the Cokerie des Charbonnages d'Anderlues, desulphurise in two stages: (a) partial recovery by the wet method, and (b) final elimination of hydrogen sulphide using ferric hydroxide. At the Brussels and Anderlues gas-works the Seabord sodium carbonate method is used, wherein much of the sulphur is lost. At Tertre they have been using the process adopted by the Dutch State mines, with ferric ferrocyanide, but it is understood that this method is likely to be modified or replaced. Other methods used in Belgium are roasting and solvent extraction, the latter including the Jacobs process.

Lastly, the author points out that in Belgium there are probably at least 500,000,000 cu.m. of town gas treated regularly with ferric hydroxide, and at 5 g. per cu. m. this should amount to 7,000 tons of sulphur per year. Reference is also made to the Hydrosulf process described some years ago (Leonet, *Rev. Gen. du Gaz*, 1935, December) in which sulphur is recovered as Na_2S. Despite these low figures for actual recovery of sulphur in Belgium, however, the potential recovery, if economic conditions justified, would total about 24,500 tons.

Centennial Celebration

300 Guests Attend Directory Luncheon

SOME 300 guests, from the Press, advertising and printing worlds, met at Grosvenor House, London, on 6 March at a luncheon to celebrate the Centennial Issue of 'The Newspaper Press Directory,' which was acquired in 1949 by Benn Brothers, Ltd., from C. Mitchell & Co., Ltd. Benn Brothers are the publishers of THE CHEMICAL AGE and other trade and technical journals.

Owing to the absence through illness of Mr. E. Glanvill Benn, the chairman of Benn Brothers, Sir Ernest Benn, presided.

The toast of 'One Hundred Issues of The Newspaper Press Directory' was proposed by Col. the Hon. J. J. Astor, chairman of *The Times*. It was not easy, nowadays, he said, to plan ahead for more than a few weeks, or even days, and it was a considerable achievement at any time to create an institution that would flourish for 100 years. He wished the directory success in the next century.

Mr. Norman French (managing director), responding, said that the founder of 'The Newspaper Press Directory,' Mr. Charles Mitchell, created in fact the first trade directory of any kind to be published anywhere. There in the first issue, Charles Mitchell advised advertisers, when looking at the circulation of an advertising medium to regard its quality rather than its quantity. To-day the quantity of newspapers was restricted, but no action of the Government or the planners could curb the desire, inherent in every journalist, to bring out day by day or week by week the very best in him for the journal he served.

Sir Ernest Benn proposed the toast of 'The Guests'; and Lord Mackintosh of Halifax, responded.

Dyestuffs Repay Science

Part Two—The Medical Uses of Some Dyestuffs

IT is not easy to understand why only some few dyestuffs should have been found to have powerful bactericidal action; it might have been thought that most dyestuffs inasmuch as they disturbed the balance of radiation falling on the bacteria would have shared this activity. This is one of the countless problems in this field still remaining to be solved. The activity of some of the dyestuffs is, however, beyond queston and it will be of interest to consider a few special cases in a little more detail.

Genesis of the Sulpha Drugs

The 'streps' are some of the most unpleasant bacteria which share this world with us and it was only in the middle of the '30s that they suffered a serious setback after a hideously successful career. This setback was caused by an azo dyestuff. As early as 1913 Eisenberg had reported that chrysoidine, a brown azo dyestuff, would destroy certain bacteria *in vitro* and in 1919 Heidelberk and Jacobs, of the Rockefeller Institute, showed that when sulphanilamide was diazotised and coupled with hydrocuperine, a dyestuff which had some lethal activity towards pneumococci was formed. In 1932, Mietzsch and Klares, of I.G., applied for a German patent for an orange-red azo dyestuff, closely akin to chrysoidine; it was first called 'Streptozon' and later 'Prontosil.' In 1933, Domagk, of the I.G., inoculated a thousand white mice, each with enough of a culture of streptococcus bacteria to kill a cat; every mouse should have died in a day or two, but each was also given Prontosil orally, and every one of the thousand survived. The experiment was repeated successfully on rabbits, and finally the life of Domagk's own daughter who had become infected by streptococci which Domagk had probably carried home on his hair, was saved when, as a last resort, Prontosil was administered to her.

The French school followed up this work and showed that although Prontosil was marvellously effective *in vivo* it was inaffective *in vitro*. Presumably, therefore, the agent that was deadly to streptococci was not Prontosil itself but a degradation product; this they found to be the case, and identifide the toxic agent as a sulphanilamide. Later this substance was the starting point for the synthesis of the M. and B. drugs sulphapyridine, sulphaguanidine, sulphathiazole, etc. The orange-red azo dyestuff for woollens was the first really effective death-dealer to streptococci and was the progenitor of the M. and B. class of drugs.

Congo Red as a Therapeutic Agent

Congo Red is of considerable interest to the dyer inasmuch as it was the first of the 'direct' colours to be discovered, the first colouring matter found to be substantive to cotton. This discovery was made by Bottiger in 1884 and although Congo Red has since found several uses, it is nevertheless surprising that it should have valuable therapeutic properties as well.

Green[32] has reported that a 1 per cent aqueous solution of Congo Red is a useful therapeutic, relatively non-toxic, and will sometimes give results in cases where the sulphonamides have failed. He reported that 50 cases of pneumonia were treated exclusively by means of a 1 per cent Congo Red solution and oxygen; in this group there was not a single death. Various other afflictions were treated with Congo Red and in one case of cerebral meningitis the dyestuff was injected directly into the spinal column; the patient responded quickly and eventually recovered. It has, of course, to be remembered that Congo Red is very closely linked chemically to the sulphonamides.

Anti-Tubercular Activity

Particular interest attaches to reports that some dyestuffs inhibit the activity of the tuberculosis bacteria. Thus Meissner and Hesse[33] as early as 1930 showed that some azine dyestuffs such as Indamine Blue had a very slight therapeutic effect in the treatment of tuberculosis. Gillissen[34] later showed that Nile Blue, Toluidine Blue and thionine dyes showed metachromasia with either human or bovine tubercle bacilli. Later, Gillissen and de Luna[35] found that basic dyes are more toxic than acid dyes to tubercle bacilli although the presence of amino groups appears to be of no importance *per se;* halogen substituents in the dyestuff molecule make it more toxic to the bacteria. Metachromatic dyestuffs, too, are especially active.

The dyestuff which was obtained by coupling diazotised *p*-sulphanilamide with *o*-chlorphenol was found by Ingle *et al*[16] to be effective in concentrations of 0.1 per cent against *Mycobacterium tuberculosis*, and so were two other dyestuffs made along similar lines, actually from (a) diazotised 3-undecyl-2,5-dihydroxy-*p*-quinone and *o*-chlorphenol; (b) diazotised 3-undecyl-2,5-dihydroxy-*p*-quinone and *o*-iodophenol.

Inhibition of Influenza Virus

Some dyestuffs inhibit the multiplication of influenza virus. Fleisher[16] has recently tested twenty-two different dyestuffs for their inhibiting action on influenza virus. He found that when the tests were made *in vitro*, the following dyestuffs were effective: Brilliant Cresyl Blue, Nile Blue A, Cresyl Violet, Janus Purple, Janus Blue G, Janus Green B, Diethylsafranineazo-4-(1-phenyl-3-methylpyrazolone-*m*-sulphonamide).

The last two were also tested by intravenous injection into mice which had been inoculated with influenza virus. When the dosage of the dyestuff was close to the LD50 (the LD50 is the smallest dose of a drug necessary to kill 50 per cent of the animals within the test period), the dyestuff prolonged the survival time of the mice. Perhaps this work may open up a new line of attack on influenza, but it must be said that there is no present indication of any approach to clinical usefulness.

Blood Clotting

The dyestuff, Congo Red, when added to the blood stream, considerably shortens the bleeding and clotting times. Green[12] reports that this dyestuff has frequently been used in cases of nose-bleeding and in post-operative bleeding with excellent results. Children who were just going to have their tonsils removed were dosed with Congo Red and suffered less bleeding, during and after the operation.

Anthelmintic Properties

Some dyestuffs have been used for the destruction of parasitic worms. Gentian Violet has been used to eliminate some types of worms from the intestinal tract, and according to Faust[17] it is the only known specific for round-worm infection (*strongyloidiasis*). It is administered in enteric coated tablets and is usually tolerated well by the human host. It has also proved effective for the treatment of pinworm. Miller *et al*[18] have reported a high proportion of cures.

The preparation of pyrimido-2′-cyanine dyes, which are claimed to be suitable for treating roundworm infestations, has been described by Brooker, Holcomb, and Banks[19].

The filarial worm *Litomosoides caranii* has also been treated with dyestuffs. It requires oxidative metabolism for its survival and very low concentrations of cyanine dyes of the order of 6.5×10^{-8} M or roughly one microgram inhibit the oxygen uptake of the worms. According to Bueding[20] the chemotherapeutic activity of the cyanine dyes in filariasis of the cotton rat is due to the inhibition effect of these dyestuffs on the respiratory action of the parasite. In another paper, Peters, Bueding, Valk, Higashi and Welch[21] report that one member of the cyanine group of dyestuffs will inhibit the oxidative mechanism of the filarial worm *in vitro* in dilutions as great as 1 in 40 million. Rats could be cured, *i.e.*, freed from the parasite, by treatment with safe doses of the dyestuff.

A clinical trial that was made with one of the cyanine dyes against filariasis, did not, however, give very satisfactory results. According to Peters[22], of Western Reserve University Medical School, Cleveland, the dyestuff 1-ethyl-3,6-dimethyl-2-phenyl-4-pyrimido-2-cyanine chloride was tried against *Wuchereria bancrofti* infections. Patients had two-millionths of their body weight of this dye injected intravenously every day. At first, microfilaria counts of their peripheral blood showed marked reduction during and immediately after treatment but unfortunately they returned in a few weeks to pretreatment levels, showing that the treatment had not killed the adult worms.

Tumours in the Dyestuff Industry

It has unhappily transpired that some of the intermediate compounds used in the preparation of dyestuffs and textile auxiliaries, possess the property of inducing growths in the people who work with them. Such growths are very slow in appearing and in a report by Goldblatt[23] it is stated that the mean period from first entrance of the person into the industry till the first discovered tumour was almost 19 years. This report concerned the appearance of 99 cases of bladder tumour, of which 58 were fatal, and all the cases appeared among workers in two

factories which made (a) aniline by reduction of nitrobenzene, (b) α-naphthylamine by reduction of α-nitronaphthalene, (c) β-naphthylamine by amidation of β-naphthol, and (d) benzidine from nitrobenzene *via* hydrazobenzene. The tumours were the most likely to be malignant when the affected worker had been working on β-naphthylamine, but malignant tumours appeared in some of those who had worked on the other compounds, too. There is no doubt that the amines had been absorbed into the body because the average daily excretion of naphthylamine (including other aromatic amines) was about 0.04 grams in 1,500 grams urine; improved working conditions later reduced this figure to 0.012 grams per day. But out of evil may come good, for the incidence of bladder cancer in the dyestuffs industry is being intensively studied to develop a new attack on the plague of industrial cancer. According to the Annual Report, British Empire Campaign[24], it is possible that the use of β-naphthylamine may be generally prohibited in industry.

Some dyestuffs, too, but apparently only those of the azo series, have some carcinogenic activity. In particular *p*-dimethylamino-azobenzene and *p*-methylamino-azobenzene and some of their derivatives have been shown to be active. If a dyestuff of this class is to possess carcinogenic activity it must, as has been shown by J. A. Miller and E. C. Miller[25], have at least one methyl group attached to the amino nitrogen atom, and the rings must bear either no substituents or carry only certain substituents preferably in the 3′ position.

Cancer Therapy with Dyestuffs

In a review of the chemotherapy of cancer, Karnofsky[26] has dealt briefly with the subject of dyes. Zahl and Waters[27] tested a series of colloidal dyes but could not demonstrate a selective uptake by tumour cells, although they did find that there was some concentration of the dyestuff in the stroma surrounding the tumour, or at the interface of the normal and cancerous tissues.

Boyland[28] tested various derivatives of the sulphonamides and found that several substances, including 4,4-diamino diphenyl ether, were effective in temporarily inhibiting tumour growth in mice. However, 4,4-diamino diphenyl ether did not prove effective on clinical trial[29].

Lewis and Goland[30,31,32] tested a long list of acridine and other dyes (oxazines, xanthines, thiazines and anthraquinones) by oral administration. Many of the dyestuffs stained tumours in mice and retarded tumour growth. They did not, however, produce regressions in growing tumours, or prevent tumours from 'taking' on transplantation. The effect of the administration of the compounds, according to Lewis and Goland, was that 'it simply slowed the rate of multiplication of tumour cells.' Of 331 acridine compounds (some of them dyes, some of them antimalarials which were given orally to tumour-bearing mice) 204 stained tumour tissue and brought about some retardation of growth, by slowing the rate of division of their cells. Of these acridines only those carrying one or more amino groups were effective. 'Sixteen of them retarded tumour growth to such an extent that when the untreated mice (controls) died (14-16 days) with tumours measuring 8,000 to 11,000 mm.³, the mice that had been fed these compounds were healthy and had tumours measuring 200 to 455 mm.³, or 1/20th to 1/40th that size.'

It is clear that the acridines slow down tumour development, but apparently do nothing to cure it. In what light this must be regarded for the future is a matter for conjecture.

Fungicidal Action

Inasmuch as some dyestuffs have been shown to attack bacteria, protozoa, and parasitic worms, it is perhaps not a matter for surprise that they should be able to attack fungi, too. In fact, mild cases of athlete's foot have been reported by Tobias[33] to benefit from treatment with a 2 per cent solution of Gentian Violet in alcohol. The triple dye mixture, already referred to, has been used for the treatment of ringworm (which is caused not by a worm but by a fungus). Another illustrative case is to be found in the work of Williams[34] who grew nineteen pathogenic fungi on peptone media containing various dyestuffs and showed that as a rule growth was more prolific when acid dyes were used, but that basic dyes were toxic.

It seems to be clear that for some purposes basic dyes are more lethal than acid dyes. In particular the frequency with which some of the commonest basic dyestuffs such as Gentian, Crystal and Methyl Violets, are used is strongly suggestive that basicity is important, but it is not easy even to make a cogent guess as to why it should be so.

There are no very special features that are evident in the properties of some of these dyestuffs; they seem to be ordinary enough. Methyl Violet, for example, is a cheap and bright colour which is used for dyeing tannin-mordanted cotton and for calico printing. It will, too, dye cellulose acetate directly, and is also used for the preparation of ink for typewriter ribbons, stamp pads, etc. Structurally it is one of the triphenylmethane groups of dyestuffs, a group which contains some of the oldest and brightest of dyestuffs.

Malachite Green, too, belongs to the triphenylmethane series; it was discovered as early as 1878. It is a basic dyestuff and dyes wool, silk, leather and acetate silk a bluish-green; it can also be used on cotton that has been mordanted with tannin and tartar emetic. It is not easy to relate such everyday properties to the medical uses of these dyes.

Phenolphthalein

Phenolphthalein is itself hardly a dye, but rather an indicator; it is, however, the simplest member of a chemical group which includes many dyestuffs. Phenolphthalein has a cathartic action and has been widely used; it seems not to suffer from the defects of most other cathartics. The story may be apocryphal but it has been related that this virtue of phenolphthalein was discovered fortuitously, as the result of a manufacturer adding phenolphthalein to one of his beverages in order to improve its colour, and indirectly enabling the dyestuff chemist to provide for yet another field of medical science.

Genito-Urinary Antiseptics

Some dyestuffs have been used as antiseptics for the genito-urinary system. Methylene Blue has long been used in medication of this sort, but is not so highly valued to-day as formerly for this purpose. It has recently been reported to stimulate uterine contraction[25].

Acriflavine has been used as a urinary antiseptic, sodium bicarbonate being given simultaneously to keep the urine alkaline. Neutral acriflavine solutions have been used as irrigating fluids in the treatment of gonorrheal urethritis in both sexes. More powerful drugs have, however, now replaced acriflavine and related acridine dyestuffs as urinary antiseptics.

Anti-Malarials

Some of the powerful anti-malarial drugs are very closely related to dyestuffs, if they are not actually dyes themselves. Atebrine is closely related to the acridine dyestuffs and actually dyes the patients who take it yellow—fortunately only temporarily.

Open Wounds

These, as has already been indicated, may be treated with acridine dyestuffs. They are sometimes syringed with a 0.1 per cent solution of acriflavine in physiological solution. Acriflavine has also been used for the treatment of suppurative infection of the middle ear.

The azo dyes, typical of which is Scarlet Red, are used not so much as general antiseptics as for wound healing. Scarlet Red has been used extensively for wounds, burns, chronic ulcers, bedsores and allied afflictions. Some dyestuffs of which Scarlet Red is typical promote growth of skin over wounds.

(To be continued)

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Two New Chemical Elements Confirmed

Properties Revealed by Optical Spectra

SPECTROSCOPIC investigations recently carried out at the U.S. National Bureau of Standards give positive identification of the two new artificial elements, technetium (Tc) and promethium (Pm), which are by-products of uranium fission. Not found in nature, the elements were supplied to the Bureau by the Atomic Energy Commission. Studies of the first optical spectra of these elements, carried out by W. F. Meggers, B. F. Scribner, and W. R. Bozman, Bureau scientists, have revealed by analysis and interpretation many properties of the atoms and of their nuclei.

Reliable wavelengths and intensity data for about 5,000 new spectral lines, the strongest of which are at least one thousand times more sensitive than their X-ray spectra, have resulted from these studies which give new impetus to a more extensive search for the elusive elements in natural sources.

For many years these two predicted elements were vainly sought in nature. One was predicted in 1869 by Mendeléeff, whose observation that chemical valencies were periodic functions of atomic weight led him to affirm that a chemical homologue of manganese was unknown. The other was predicted in 1902 by Brauner, who pointed out that the atomic weights of neodymium and samarium differed by six units whereas the average difference in weight of proximate rare earths was only three units.

Further Efforts Inspired

Many of the chemical and physical properties of these missing elements could be predicted from their positions in the periodic chart of the atoms, and this inspired countless attempts at discovery, most of which were never reported because they ended with negative results. In 1913 the discovery by Moseley of a simple relation between X-ray frequencies and atomic numbers fixed the atomic numbers of the two elusive elements as 43 (techetium) and 61 (promethium) respectively, and inspired further efforts to detect them in chemical concentrates from ores.

Thus, in 1925, three German scientists published three X-ray wavelengths as proof that they had concentrated and identified element number 43 which they named masurium. This discovery, however, was never repeated or confirmed. Likewise, in 1926, X-ray evidence for the discovery of element 61 was reported almost simultaneously by two groups of American scientists and by a pair of Italian chemists. The Americans named it illinium, the Italian florentium. These discoveries also were never later verified.

Transmutation Yield Small

After the discovery of artificial radioactivity in 1934 by Joliot and Curie it became theoretically possible to manufacture these unseen elements by transmutation of others, and because element 43 was indeed first technically produced in 1937 by neutron bombardment of molybdenum 42 it was named technetium. But the transmutation yield, even with the largest cyclotrons, is very small. With the construction and operation of chain-reacting uranium piles in 1942, an entirely new and vastly more efficient method of making the missing elements became available. When uranium undergoes fission, 6.2 per cent of the atomic fragments become atomic number 43, and 2.6 per cent become atomic number 61.

In 1949, the National Bureau of Standards received from the Oak Ridge National Laboratory several milligrams of each of these fission products for the purpose of making reliable descriptions and analyses of the spectra characteristic of these artificial elements. A total of 4 milligrams (0.00013 ounce) of highly pure Tc was used to photograph the arc and spark emission spectra with a large diffraction grating. The spectra were recorded several times from the ultra-violet (2200 Å) to the near infra-red (9000 Å), and between these limits the wavelengths and relative intensities of about 2,300 radiations characteristic of Tc atoms and ions were determined. By comparing intensities in arc and spark excitation the lines could be definitely assigned to either neutral Tc atoms or to singly ionised (Tc) atoms.

Analysis of the data of the first spectrum of Tc shows that in the normal unexcited state Tc atoms (like Mn atoms) have five d-type and two s-type valence electrons. Some 200 lines, representing two-thirds of the total observed intensity, have been explained as transitions between 20 spectral terms

belonging to quartet, sextet, and octet systems. A spectral series extrapolated to an ionisation limit shows that energy of 7.45 electron volts is required to remove from a Tc atom its last bound electron.

Two milligrams of Tc were reserved for the investigation of the hyperfine structure of certain lines. For this purpose the sample was excited at very low pressure in a hollow cathode cooled with liquid nitrogen to sharpen the lines, and the radiations were examined with interferometers of high resolving power. From the number and spacing of hyperfine components it was found that the nuclei of Tc atoms with 43 protons and 56 neutrons have a mechanical moment of $9/2$ $(h/2\pi)$. Furthermore, the same Tc atomic nuclei were found to possess a magnetic moment of about 5.2 nuclear magnetrons.

Rare Earth Character Shown

Five milligrams of Pm were made available for an investigation of the absorption and emission spectra. The rare-earth character of this sample was immediately disclosed by strong bands in its absorption spectrum and by an extremely complex emission spectrum when excited by electric arcs or sparks. The principal absorption bands were observed to have wavelengths 494.5, 548.5, 568.0, 685.5 and 735.5 millimicrons, in excellent agreement with earlier measurements made by the Oak Ridge National Laboratory on another sample. The arc and spark emission spectra of Pm were recorded photographically with a large diffraction grating, and the wavelengths and intensities of more than 2,200 lines were determined between the ultraviolet (2300 Å) and the red (6900 Å).

Unfortunately, it was not possible with the sources employed to differentiate the spectral lines of neutral and of ionised Pm atoms, and the sample was too highly radioactive to recover for further experiments. Consequently, the preliminary description of the emission spectrum of Pm, although it confirms the discovery of the long-sought rare earth and provides a sensitive test for future identification of Pm, is at present inadequate for structural analysis and derivation of atomic energy levels. These preliminary observations call attention to hyperfine structure of Pm lines, indicating that the nuclei of Pm atoms with 61 protons and 86 neutrons possess mechanical and magnetic moments deserving detailed study.

Although several different isotopes of both Tc and Pm have been made artificially they are all radioactive. The most stable identified isotope of Tc has atomic mass of 99 and a half-life of about 500,000 years, whereas for Pm the corresponding quantities are 147 and 3.7 years. The present knowledge concerning nuclear stability does not definitely deny the existence of possible production in nature of other isotopes of Tc or Pm. Thus, the provisional spectroscopic identification of Tc in the sun seems to require either a longer-lived isotope or possibly the transmutation of Mo.

These considerations have spurred sensitive searches for Tc in terrestrial materials, and will probably lead to similar searches for Pm in natural sources. The new information about chemical and physical properties of artificial Tc and Pm can now be applied to concentration and separation without loss on account of such factors as high volatility and co-precipitation.

Finally, for positive proof of the presence of these elusive elements there are now reliable data on their uniquely characteristic optical spectra. The strongest lines of neutral Tc atoms have wavelengths, in angstroms, and relative intensities (in parentheses) as follows: 4297.06 (500), 4262.20 (400), 4238.19 (300), 3636.10 (400). Similar data for singly-ionised Tc atoms are: 2543.24 (1000), 2610.00 (800), 2647.02 (600), 3257.2 (400), 3212.01 (300), 3195.21 (200). The strongest lines of Pm atoms, probably singly ionised, have wavelengths and intensities as follows: 3998.96 (100), 3957.74 (100), 3919.09 (100), 3910.26 (100), 3892.16 (100). These wavelengths and relative intensities are the most sensitive and critical criteria for the detection of Tc and Pm, respectively, in nature.

February Steel Record

Steel production in February, including the last two weeks of private enterprise (prior to nationalisation on 15 February) was at an annual rate of 16,952,000 tons. This is the highest rate ever achieved in February and was 54,000 tons more than the same month of last year. Output of pig iron also increased, being at an annual rate of 9,687,000 tons compared with 9,588,000 tons in February, 1950.

Broadening the Chemist's Outlook

Avoiding the 'One-track' Mind

THE need to have a broad human outlook and, although they might be specialists, to avoid the dangers of a 'one-track' mind were the main themes of the speakers at the annual dinner and dance of the London section of the British Association of Chemists held in London on 9 March.

Proposing the toast of the London section, Major S. E. Porter, T.D., B.Sc., president-elect, said he believed it was the first section to invite ladies to its gatherings.

Miss W. Wright, B.Sc., F.R.I.C., replying, emphasised the need for looking ahead. Although we might all tend to regret the passing of the good old days we must not only live for the present but also plan for the future. Unity and loyalty, she suggested, should be the motto for the BAC. Loyalty in the things which needed doing and unity to pull together in accomplishing them. The BAC and the London section had been fortunate in the people who had helped it and continued to do so, but she felt that it should not be too dependent and should strike out for itself and be an orphan—if need be an orphan of the storm.

'Our Guests,' was proposed by Mr. H. T. F. Rhodes, although he said he had been told that, as chairman, it was not really right for him to give this toast. After his long association with the BAC as a member of the London committee, assistant secretary, editor of the journal and a member of the council, he felt he must take this opportunity which might not occur again. A great feature of the BAC functions was that guests had frequently written to say it was a pleasure to attend because 'although they sometimes did not know us very well,' they felt they were among friends.

The BAC had been fortunate in its visitors and tonight was no exception. Professor Soddy needed no introduction, he was undoubtedly one of the great chemists of our day. He had been associated with Rutherford in his early researches and his work on radioactive disintegration had led to the discovery of isotopes. He was awarded the Nobel prize for chemistry in 1921. It had been said that chemists tended to get to know more and more about less and less. This was certainly not true of the professor, who was noted in many other fields—particularly economics and the social relations of science.

Another guest whose name he would like to associate with the toast, continued the chairman, was Mr. Harold Rhodes, C.B., an under secretary of the Treasury and a director of organisation, Ministry of National Insurance. Here again was a man, who had studied chemistry when young, and whose interests were wide. He could talk on any subject.

Turning for a moment to the BAC, Mr.

A photograph of the stand of A. Boake, Roberts & Co. Ltd., at the Oil and Colour Chemists' Association Technical Trade Exhibition, which is being held at the Borough Polytechnic on 19, 20 and 21 March.

The firm are showing a speciality range of stearates, solvents, plasticisers, resins, driers, anti-oxidants and reodorants, all of which are sold under the ABRAC *house mark. The panels shown illustrate the end use of new or improved paint, varnish and lacquer raw materials.*

The stand was designed by ABRAC *Publicity Department and was built by the* ABRAC *Building Department.*

H. T. F. Rhodes said one of its main points was that a man was a human being first and a chemist afterwards, and members were encouraged to take an interest in subjects not associated with their own special activities. The BAC also held a unique position as experts in the legal aspects of chemistry, and the employment of chemists. Its appointment service made every endeavour to find the right man for the right job.

The international scene, said the chairman, he approached with some diffidence, but it could not be ignored. He agreed with the old saying that there were no good politicians—it was merely that some were worse than others. It had occurred to him, and no doubt to others, that the scientists and technicians might well play an important rôle in advising the statesman to adopt broader views.

Saner Councils Urgently Needed

Professor F. Soddy, M.A., F.R.S., replying, said that he very much appreciated the friendly atmosphere. He agreed that there was a vast amount of goodwill among the common peoples of the world, but he felt that it was time for the scientific men to take their own line and stand firm by it. At the moment they seemed to be drifting in a most perilous situation. Men must once more learn to live amicably together. Unless saner councils prevailed, the calamity of a third world war was inevitable.

Mr. Harold Rhodes, C.B., said that the only speech he had ever been known to make with conviction was 'Same again, please, miss.' He had always venerated chemists and believed that we owed them a great deal not only for their work but for the manner in which they maintained a level outlook. He had himself worked in a Government laboratory for four years, but had had to abandon it because of ill-health. The necessity for getting outside the limits of their profession was one which might well be considered by many others besides chemists with mutual benefit to all.

Before adjourning for the dancing the chairman said he would like to express the appreciation of all present to Mrs. M. E. Good for the excellent arrangements. In the absence of Mr. O. W. Petzold in Germany she had borne the brunt of organising, what he was sure all would agree, was a most successful evening.

Joint Meeting in Liverpool

North-Western Chemical Engineers Hear Paper

A JOINT meeting of the Liverpool and North-Western Section of the Society of Chemical Industry, the Chemical Engineering Group and the North-Western Branch of the Institution of Chemical Engineers was held at Liverpool on 10 March. A paper, 'The Re-activation of Bone Charcoal' was presented by Messrs. W. L. Howe and A. M. Moult, B.Sc.

The authors described the use of bone charcoal for the decolorisation of sugar solutions and the re-activation of the spent charcoal in indirectly-fired pipe kilns. The good charcoal is placed in large cylinders through which sugar solution flows until the colour of the filtered solution deteriorates, when the inlet valve is closed and the sugar washed by water from the spent charcoal. The charcoal is further washed to remove mineral matter, is drained and then heated in closed pipe kilns at 850-950°F. to reactivate it by distillation or carbonisation of the organic impurities. Carbonisation by this method blocks the pores of the charcoal and decreases the surface effective for decolorisation. To prevent this deterioration, controlled carbonisation experiments were made with the charcoal exposed to the direct action of the products of combustion of town gas.

Laboratory Experiments Extended

These laboratory experiments were extended to large-scale operations with a Nichols-Herreshoff kiln which had seven firebrick hearths each with two rabble arms rotating at two to three r.p.m. Town gas was used as a fuel to provide a non-oxidising atmosphere with no unburnt gases and some of the products of combustion were re-cycled through the kiln to prevent overheating of the charcoal in the kiln which was operated under vacuum. Perfect combustion of the town gas was obtained by the use of Calyx flames regulated by a gas/air carburettor. Wet charcoal is dried on the top hearths of the kiln, travels counter-current to the rising hot gases and is finally cooled by a water-cooled tubular cooler. Uniformly good quality, sterile charcoal was obtained and attrition was no greater than was obtained by reactivation in retorts.

HOME

Subscription Raised

In consequence of heavily increased costs of production, the subscription to THE CHEMICAL AGE will be raised to 35s. per annum on and after 1 April, 1951. This covers delivery of 52 weekly issues of THE CHEMICAL AGE post paid, together with one copy of THE CHEMICAL AGE YEAR BOOK.

Single copies of THE CHEMICAL AGE are 9d., or post paid 1s.

Sales Director visits Australia

Mr. Rodney Kent, sales director of George Kent, Ltd., London and Luton, sailed for Australia at the beginning of this month, accompanied by Mrs. Kent. This is Mr. Kent's first visit to the Dominion. He will tour branches and agents of the firm during his six week's stay and will then fly to New Zealand where he and Mrs. Kent will spend two weeks. After a further month in Australia Mr. Kent will return to England by air via America where he will stay for some days.

The Chemical Society Anniversary

The 1951 Anniversary Meetings of the Chemical Society will be held at Burlington House, London, W.1, on 21-22 March. The presidential address entitled 'Concepts in Catalysis—The Contributions of Paul Sabatier and Max Bodenstein' will be given by Professor E. K. Rideal at 4 p.m. on 21 March followed by a reception and conversazione at 6.30 p.m. The 110th Annual General Meeting will be held the following day at 11.30 a.m. in the Society's Meeting Room. Visits to research establishments have been arranged and the meetings are concluded by an Anniversary Dinner at the Savoy Hotel, commencing 7.30 p.m.

Lead and Zinc from Scotland

World shortage of lead and zinc has roused considerable interest in the project to reopen the mines at Warlockhead in South-East Scotland and Strontian, Argyllshire. A representative of a syndicate interested in the Strontian scheme was reported last week to have stated that he was certain work would be begun this summer. Resumption of mining at Wanlockhead was earlier this year said to be problematical because of the cost of draining the flooded workings. A further survey has, however, since been made by the Johannesburg Consolidated Investment Co., Ltd. The Ministry of Supply is said to be co-operating.

Fine Chemicals Group Nominations

Nominations for election to the committee of the Fine Chemicals Group of the Society of Chemical Industry are now invited. Under the rules of the group the following members of the committee retire in July and are not eligible for immediate re-election: Dr. J. D. Kendall, Dr. J. C. McGowan and Mr. F. A. Robinson. In addition there are two vacancies owing to the resignation of Sir Jack Drummond and the appointment of Dr. S. H. Harper to the post of honorary recorder on the impending retirement of Dr. F. Hartley from that office. Under rule 6, nominations signed by the candidate and not less than two members must reach the secretary not later than 31 March. Vacancies on the committee will be filled by election at the annual general meeting of the group on 20 April. If more than five nominations are received, election will be by ballot at this meeting. Those elected will assume office immediately after the annual meeting on 9-13 July.

Visit to Northern Italy

Mr. P. N. O'Donaghue, honorary organising secretary for the summer tour being arranged by the Food and Agricultural Groups of the Society of Chemical Industry, has released a few details of the tentative arrangements which have been made. It has been decided to visit Northern Italy and the party will leave London on the morning of Friday, 1 June, by train, arriving in Milan on the following morning. Sleeping accommodation for the overnight journey from Paris to Milan will be provided. The party will stay in Milan for the period of the tour, returning on Saturday evening, 9 June, arriving in London approximately 24 hours later. Arrangements are being made to visit factories and other establishments of interest in Northern Italy. The cost per head will be approximately £50. Further details and forms of application will be sent to members when arrangements are sufficiently advanced.

Technical Publications

THE Aluminium Development Association has recently published an informative pamphlet on aluminium and alloys, as the first of a series of bulletins concerning the metal. This issue being the first, it deals largely with the history of aluminium, its distribution in the earth's crust, the location of the industry, and its production, properties and uses. Future issues will deal with the subject more technically.

An interesting little booklet, this issue tells of how aluminium was first recognised in 1807 by Sir Humphrey Davy, but not purified until 1825. Of how the original price of the metal was £1 per lb., and of its subsequent fall in cost due to the discovery of the mineral cryolite which was used as a solvent for the aluminium ore. 'Eros' in Piccadilly was made of aluminium in 1893, and the famous 'Y' alloy developed in the first world war was the first aluminium alloy to be used for aircraft components. Altogether, this pamphlet gives an interesting insight into the origins of the metal.

A PAMPHLET on the bonding of rubber to metal has just been issued by Aero Research, Limited, Duxford, Cambridge. The advantage of using rubber for reducing vibrations between metal parts is obvious, but up to now the only method known for bonding the rubber to the metal has been the brass-plating process—expensive, requiring close control, and employing poisonous cyanides. Metal-to-metal bonding in recent years has been made possible by employing a polyvinyl formal powder in conjunction with a phenol-formaldehyde resin to wet the surfaces, but it was found impossible to bond rubber to metal by this method. Recently, however, this 'Redux' process has been adapted successfully to metal-rubber bonding by taking a leaf out of a text-book of 1882 and treating the surface of the rubber with concentrated sulphuric acid for a few minutes. This converts the rubber into more easily adhesible isomers, when it is washed and dried and the liquid resin mixture applied by brush after the metal has been thoroughly degreased and cleaned. Applied pressure of 50 p.s.i. at 140 deg. C. for 20 minutes then cures the resin and forms a bond that seldom fails before the rubber does itself. The advantages of this process are easy application, absence of special apparatus (an acid bath, an oven and clamps are all that are required), and cheapness. There are, of course, occasions where the brass-plating process is better, notably when the vulcanisation and bonding are best carried out in the same operation, but in the very large number of uses to which rubber-bonded materials can be put, and this includes everything from machine parts to lightweight horse-shoes, the majority will be using already vulcanised rubber, and using it on the premises. The only limitation that this method appears to have is that it will not bond silicone rubbers.

THE REFRIGERATING trade will welcome the 1951 issue of the buyer's guide to British Refrigerating Material. Price 20s., it is a comprehensive directory of the refrigeration industry, including manufacturers, materials and machinery, instrumental equipment, and Government and scientific bodies connected with the industry. No details have been spared concerning the plant and accessories produced by the various firms, and there is a technical information and tables section for the use of engineers.

CURRENT restrictions on the use of nickel in steel have forced engineers associated with the design, fabrication and application of equipment using vital chrome-nickel stainless steels to investigate the use of straight chromium stainless grades. To assist in solving the problem, the Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania, has published a new four-page bulletin outlining the physical and mechanical characteristics of three non-hardening straight chromium stainless tubing steels. Known as Bulletin TDC 140, (available free on request to the company at Beaver Falls), it discusses B & W Croloy 18 A1 (AISI Type 405), B & W Croloy 18 (AISI Type 430) and B & W Croloy 27 (AISI Type 446). Included in the bulletin are technical data on analyses, creep strength, properties at room and elevated temperatures, corrosion and oxidation resistance, forging, forming, machining, welding and heat treatment.

The Chemist's Bookshelf

A HISTORY OF THE CHEMICAL INDUSTRY IN WIDNES. By D. W. F. Hardie, Ph.D. Published by Imperial Chemical Industries, Ltd., General Chemicals Division. Birmingham. 1950. Pp. 250. 21s.

Despite its flat, rather uninteresting title, this book has all the fascination of those nature films which, by employing time-lapse cinematography, reveal and demonstrate to us the difficultly assimilable facts of plant germination and growth.

The author, Dr. Hardie, who is to be congratulated on a scholarly piece of research, has given a sudden illumination to the seemingly trivial facts which occupy the opening pages of endless elementary text books, and there is no doubt that future writers of such books will be heavily indebted to him.

The story, which opens with the importation to Britain of the artificial soda process of the unfortunate French surgeon LeBlanc, is the more interesting because it is linked with the rise of Britain's economic might and her early struggles for self-sufficiency. Parallels with our present day difficulties are many, the conservation of sulphur being as important then as now, although for a different reason. But there is another and more melancholy story, the story of the devastation of a pleasant countryside, the conversion of green fields into a nightmarish landscape, perpetually obscured by drifting clouds of hydrochloric acid gas, and covered by mounds of evil smelling, spontaneously inflammable alkali waste. The expansion of the chemical industry is traced from the early adventures of James Muspratt, through the operations of the United Alkali Co., to the formation and organisation of Imperial Chemical Industries, General Chemicals division. It is to be hoped that other books of this type may be published, giving the histories of other chemical manufacturing towns, such as Ludwigshafen for instance.

The foreword, by Sir Frederick Bain, is in a flowery style strangely at variance with the objective manner of the author. We should do well to remember that the early chemical manufacturers were hard-headed industrialists, who, important as they were to economic progress, were mainly interested in the success or failure of their commercial ventures.

The book is well indexed and has an appendix containing personal details of the lives of many chemical manufacturers.—J.R.M.

GLOSSARY OF TERMS USED IN THE PAINT, VARNISH, AND ALLIED TRADES. By H. W. Chatfield. Scott Greenwood & Son, Ltd., London. Pp. 200 + xii. 30s.

Most authors when they come to compile a glossary of terms used by any particular section of the community find themselves, sooner or later, faced with the problem of where to draw the line. Are they, for instance, in a glossary for the paint trade, to cater for the relatively knowledgeable technician who may want to pinpoint an abstruse term or put himself right with the language of a neighbouring trade, or are they going to please the novice who may know little or nothing about the trade, and to whom technical terms have to be learnt like French irregular verbs?

Dr. Chatfield has, on the whole, struck a satisfactory balance between the two. The paint trade, occupied as it is with a large chunk of what on the theory side is organic and inorganic chemistry has necessarily got to use a very large number of chemical terms. Consequently, a glossary of these terms is likely to look quite like a potted organic chemistry for beginners, and Dr. Chatworth's book does not escape this. At least 50 per cent of the terms indexed are quite familiar to a trained chemist. It would be presumptuous, however, to assume that the paint trade is made up solely of trained chemists, or that this would be in any way desirable, and Dr. Chatworth has succeeded very well in satisfying both fields —in putting the technician wise to chemistry, and enlightening the chemist on trade and technical terms in common usage.—J.C.S.

· PERSONAL ·

At a meeting of the directors of the International Nickel Company of Canada, Ltd., MR. R. L. PRAIN, O.B.E., London, was appointed to the board. Mr. Prain who is well known in mining circles in the City is chairman, Rhodesian Selection Trust, Ltd.; chairman and managing director, Roan Antelope Copper Mines, Ltd.; chairman and managing director, Mufulira Copper Mines, Ltd.; chairman, Anglo Metal Co., Ltd., and a director, Climax Molybdenum Company of Europe, Ltd.; in addition to holding directorships of several other companies mainly connected with mining.

The appointment of MR. J. D. SUTCLIFFE as commercial director of Richard Sutcliffe, Ltd., has been announced.

Continuing their policy of re-centralisation, Thomas De La Rue & Co., Ltd., have appointed MR. MAURICE B. JORDAN to be general sales manager of the Extrusions and Flooring section of the business. Mr. Jordan, who joined the company in 1949, will, in addition to his new duties, continue to operate as general sales manager of the Plastics Division.

MR. JAMES RICHARDSON DONALD, president of J. T. Donald & Co., Montreal consulting chemists, and Donald Ross & Co., chemical engineers, has been drafted for the third time into the government service, this time to become controller of chemicals and to head a new chemical division of the Department of Trade and Commerce. The chemicals control will follow largely the pattern of steel, and is expected to include rubber, since Canada's main supply is the synthetic product of the Polymer Corporation at Sarnia. For the moment the job will be one of merely making sure that the materials are made available for explosives and other defence contracts. Mr. Donald's authority will stem from the Essential Materials Act, although as yet no ministerial order has been issued either for non-ferrous metals or chemicals.

The Council of the Electrodepositors' Technical Society has awarded the E.T.S. Gold Medal for 1951 to DR. S. WERNICK. The medal, which represents the highest award in the gift of the Society, will be presented at the Annual Conference to be held at Torquay in April.

Dr. S. Wernick is the honorary secretary and chairman of the Publications Committee of the Electrodepositors' Technical Society of which he is also a past president. He has carried out and directed considerable research in the electro-metallurgical field, which has led to numerous publications. He has specialised in metal finishing for the automobile industry, and is the author of a recent book on 'Electrolytic Polishing and Bright Plating of Metals.'

A graduate of London University, Dr. Wernick is a Fellow of the Royal Institute of Chemistry, and Fellow of the Institution of Metallurgists. He is a consultant to a number of leading industrial concerns, which include the Austin Motor Co., Ltd., Wilmot-Breeden, Ltd., and W. & T. Avery, Ltd.

At the annual general meeting, the president of the E.T.S., Mr. A. W. Wallbank, announced that the Council had conferred the distinction of honorary membership on DR. WILLIAM BLUM. Dr. Blum has been associated for very many years with the Bureau of Standards, Washington, and his researches in electrodeposition have contributed greatly to progress in this field. He is the co-author of 'Electroplating and Electroforming' with Mr. G. B. Hogaboom, one of the best known books on electrodeposition practice which has had a vogue of more than twenty years and has recently been issued in revised form.

Obituary

WILLIAM CHARLES GEORGE LUDFORD, of Fern Lea, Four Oaks, Sutton Coldfield, died at his home early in the morning of Thursday, 8 March, 1951, in his 85th year. Nearly fifty years ago Mr. Ludford founded the Four Oaks Spraying Machine Company, whose machines are known all over the world, and of which he was the sole proprietor. He took the greatest possible pride in his business, to which he devoted nearly fifty years of his long life. He leaves two sons, who are the surviving directors of his business, now a private company, of which he was managing director at the time of his death.

OVERSEAS

Chemical Shortages in Canada

Effects of the U.S. allocations imposed on numerous chemicals are now beginning to show their effect in Canada, while some suppliers in Canada have imposed allocations voluntarily. Such Canadian-produced items as muriatic acid, sulphuric acid, caustic potash, ethanolamines and various organics, are among those affected. The acute shortage of sulphur and chlorine is having a widespread effect in various acids and chemicals for which these items form the base. Of the alkalis, caustic soda remains in reasonably good supply, as does soda ash. Alcohols have fairly good deliveries, but some solvents, especially those used in the paint industry, tend to become short.

Canadian Chemical Development

Canada's chemical self-sufficiency drive is speeding up. Latest important chemical to be produced for the first time in Canada is anhydrous aluminium chloride. The Aluminium Company of Canada recently started production of the chemical at its Arvida plant. Annual output will be about 3,000 tons, enough to supply the entire domestic market and leave a considerable portion for export. Chief Canadian consumer will be the Polymer Corporation synthetic rubber plant at Sarnia, Ontario, which has contracted to take 300 to 400 tons annually.

Government Takes Over

In order to regulate the acquisition of tin, it was announced in Washington early this week that the Reconstruction Finance Corporation had been made the sole importer of the metal for the U.S.A. It was also announced at the same time that the National Production Authority would place tin under allocation control as from 1 May. Allocations for the third quarter of 1951 are expected to be about 80 per cent or less of the average consumption in the base period—that is, the first six months of last year. Consideration is said to be given to a similar order for tungsten.

New German Medicine

Claims that a new drug called 'paracillin', discovered by German chemists, is in many ways superior to penicillin are made by the German Medical Association. It was produced at the Grünenthal Chemical Factory at Stolberg in the Rhineland, but no plans have yet been made to patent it or put it on the market. Advantages claimed for 'paracillin' over penicillin include: greater concentration so that smaller doses have equal efficacy; it can be kept in liquid form for one year.

To Obtain More Tannin

Chestnut trees, killed many years ago by a disastrous blight, may form an important contribution to America's reserves of scarce strategic materials under a programme now being considered by the U.S. Government. The trees, from which tannin is extracted, are mostly in the national parks. During the war limited access to them was permitted, and it is thought that, subject to restrictions against defacing the Government's woodland areas, extractors of tannin may once again be allowed to make use of the trees . The Government is also considering the possibility of obtaining tannin from cultivated crops such as canaigre, test plantings of which have been made.

Titanium Production Doubled

Output of titanium metal is reported to have been increased to 2,000 lb. a day in the U.S.A. by the development of new production techniques. This is a 100 per cent gain over the output of a few months ago. The U.S. Navy recently developed a lightweight alloy of 92 per cent titanium for use in jet aircraft, while U.S. Army ordnance tests have shown that a .5 in. plate of the metal resists penetration better than alloy steel of the same thickness.

Norway's Atomic Pile

Production is expected to begin shortly at the reactor for production of atomic energy in Norway. Its planning and construction by the Norwegian Institute for the Study of Atomic Energy has been in progress for three years. Norway, which produces uranium and heavy water, becomes the sixth country in the world to have an uranium pile in the production of atomic energy. Up to now, isotopes have been imported from Great Britain.

Next Week's Events

MONDAY 19 MARCH

Royal Institute of Chemistry

Dartford: The Bull Hotel, 7.30 p.m. F. Greenaway: 'Some Experiences of a Chemist in the Museum Service.'

Electrodepositors' Technical Society

London: Northampton Polytechnic, St. John Street, Clerkenwell, E.C.1, 6 p.m. L. A. J. Lodder: 'The Production of Zinc Alloy Die-castings with Particular Reference to Requirements for Finishing.'

Society of Chemical Industry

London: School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 6.30 p.m. Three papers will be read and discussed.

TUESDAY 20 MARCH

Society of Chemical Industry

London: Manson House, 26 Portland Place, W.1, 6.30 p.m. Dr. P. A. Small: 'Some Factors Affecting the Solubility of Polymers.'

Hull Chemical and Engineering Society

Hull: Church Institute, 7.30 p.m. E. C. Mantle: 'Non-ferrous Alloys.'

Institute of Metals

Swansea: University College, Singleton Park, 6.30 p.m. Annual general meeting.

WEDNESDAY 21 MARCH

Royal Institute of Chemistry

London: Waldorf Hotel, Aldwych, W.C.2. H. N. M. H. Irving, F.R.I.C.: 'Some Fundamental Problems of Analytical Chemistry.'

Institute of Metals

Sheffield: Grand Hotel, 6.30 p.m. Annual general meeting.

THURSDAY 22 MARCH

The Chemical Society

Aberdeen: Marischal College. Dr. W. T. H. Williamson: 'Chemistry in Relation to Soil Science.' (Jointly with RIC and SCI.)

Institution of Chemical Engineers

Chester: City Library, John Street, 7 p.m. L. L. Gush: 'Chemical Engineering and Our Institution.'

Aluminium Scrap Controls

Maximum Prices Fixed

THE Minister of Supply, Mr. George R. Strauss, has made an Order fixing the maximum prices of aluminium scrap. This is to discourage hoarding and stabilise scrap prices, so that they are in reasonable relation to the price of virgin metal.

The Order—Aluminium Scrap Prices Order (S.I. 1951 No. 391)—has been made after consultation with the trade, and came into operation on 12 March, 1951.

Over the past few months scrap prices have soared; in certain cases they have exceeded the price of virgin ingots. The effect has been to encourage speculation, and to create an unstable state of affairs which was threatening the structure of the secondary aluminium producing industry, at a time when the demand for secondary metal to meet the rearmament programme and other essential requirements were rapidly increasing.

The fixed maximum prices will be as follows:—

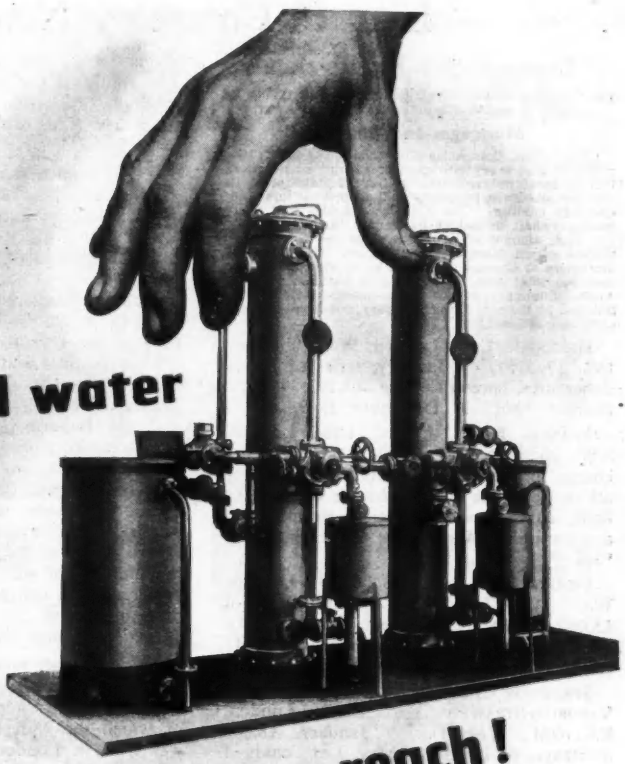
Trade description	Prices per ton delivered	
	Ex works	Buyers' address
	£	£
New pure aluminium scrap (excluding foil scrap)	96	105
Old rolled pure aluminium scrap (excluding foil scrap) ..	86	95
Clean aluminium alloy scrap ..	81	90
Aluminium turnings	59	70

The Order provides a formula for fixing the maximum prices of any types of aluminium scrap not included in the list. All prices are subject to abatement for inferior quality or lack of cleanliness, and an additional 2s. 6d. per bag has been allowed for bagging.

The Order requires records to be maintained of all scrap transactions, describing the material sold and the price charged.

Textile Conference

British and overseas members of the Textile Institute will assemble at Brighton for its annual conference from 21-25 May. 'Textiles—their Past, Present and Future,' will be the subject of the discussions at which some 36 papers will be delivered.



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Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

HELIOGEN, LTD., London, W.C., chemists. (M., 17/3/51). 4 January, series of £1,500 debentures, present issue £1,100; general charge. *Nil. 31 December, 1949.

FRANCIS HICKS & CO., LTD., London, S.W., chemists. (M., 17/3/51). 1 January, charge to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on 80 Battersea Bridge Road and 1a and 2a Westbridge Road, Battersea. *Nil. 19 July, 1950.

INDUSTRIAL CHEMICALS, LTD., London, W.C. (M., 17/3/51). 5 January, series of £5,000 debentures, present issue £1,000; general charge. *£5,000 debentures. 17 October, 1950.

STRAWSON CHEMICAL CO., LTD. (formerly VAPORITE-STRAWSON CO., LTD.), London, E.C. (M., 17/3/51). 9 January, £8,000 mortgage, to Bryant & May, Ltd.; charged on land with building thereon known as The Pioneer Works, Mashgate Lane, Stratford (Essex). *—. 12 April, 1950.

THERMAL SYNDICATE, LTD., Wallsend. (M., 17/3/51). 5 January, £10,000 debentures, part of a series already registered. *£20,000. 14 April, 1950.

Company News

African Explosives and Chemical Industries, Ltd.

Net profit of African Explosives and Chemical Industries, Ltd., for the year ended 30 September, 1950, was £901,686 (£695,797). A final dividend of 3 per cent is announced, making a total of 9 per cent on the £8 million ordinary capital. No dividend was paid for the previous year on the existing £3,500,000 ordinary capital, but a capital bonus of 14 2/7ths per cent was distributed. The whole of the ordinary capital is held in equal proportion by Imperial Chemical Industries, Ltd., and De Beers Industrial Corporation.

Manchester Oil Refinery

After allowing £167,916 (£123,944) for depreciation, interest, etc., group profit of the Manchester Oil Refinery for 1950 was £351,212 (£141,380). A final dividend of 10 per cent on the ordinary shares (same) is recommended, making a total of 20 per cent (10 per cent). It is proposed to issue part of the recently created £175,000 new ordinary capital and details are expected to be available at the annual meeting on 30 March.

Laporte Chemicals, Ltd.

An extraordinary meeting of Laporte Chemicals, Ltd., will be held on 30 March. Shareholders will be asked to approve the creation of eight million ordinary shares of 5s. each, raising authorised ordinary capital from £1,825,000 to £3,825,000 and the merging of the two existing classes of preference by converting 'A' £6,000 6 per cent cumulative 'A' preference stock into 7½ per cent cumulative 'B' preference.

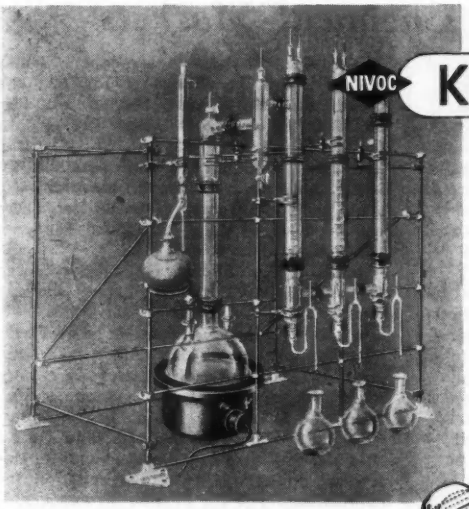
Tate and Lyle, Ltd.

Overseas business was responsible for the improvement in trade of Tate and Lyle, Ltd., of which the 48th annual general meeting was held in London on 7 March. The value of exports was £29 million and 55 countries were concerned. Home trade decreased due to cuts in sugar and syrup. Application to restore the value of the ordinary stock unit from 15s. to £1 out of reserves was refused by the Capital Issues Committee, no reasons being given.

Increases of Capital

The following increases of capital have been announced: IMPERIAL CHEMICAL INDUSTRIES (TURKEY), LTD., from £30,000 to £180,000; EAGLESCLIFFE CHEMICAL CO., LTD., from £250,000 to £300,000; LAURENCE & DAVIES (CHEMISTS), LTD., from £2,000 to £10,000.

The authorised capital of The Clayton Aniline Company, Limited, has been increased to £1,600,000.



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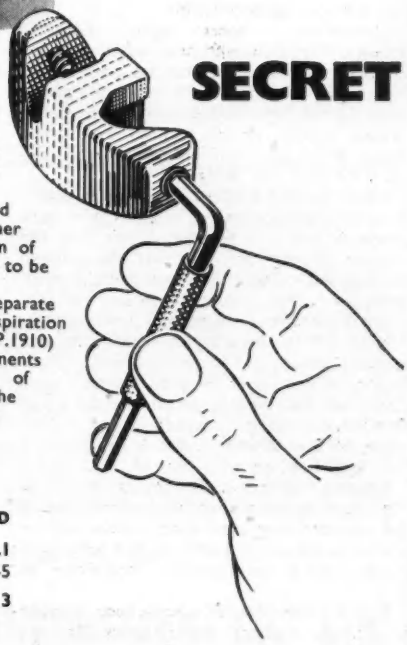

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The Stock & Chemical Markets

MARKETS have been in hesitant mood and values in most sections were again easier. This was mainly due to caution by buyers rather than to selling, which was regarded as moderate, particularly when bearing in mind the substantial gains recently made in industrial shares. There is a disposition to await international developments, and moreover the Persian news which led to a sharp decline in Anglo-Iranian oil shares, also affected sentiment.

The coming Budget has, however, been the main factor because of general expectations that there will be a further heavy increase in the tax burden, which will presumably limit considerably the scope for higher dividends. In recent months a number of companies have made their dividend payments earlier than usual. In the City this is regarded as an indication that future taxation will bear heavily on company profits.

Commodity shares again displayed activity, for although these have probably reached their zenith, most tin and rubber companies would be able to earn good profits even if prices were to fall substantially below present levels. British Funds have turned easier, which also reflected the general tendency to await the Budget.

Chemical and kindred shares were uncertain, but movements on balance have been generally small. It seems that for the present, at any rate, chemical shares must be expected to move closely with the general tendency in the industrial section of the Stock Exchange. Imperial Chemical were 43s. 9d. F. W. Berk 2s. 6d. shares remained around 13s. 6d., and Monsanto were good up to 56s. 3d. on higher dividend hopes. Lawes Chemical 10s. shares were 13s. 3d., and Brotherton changed hands around 21s., while William Blythe 3s. shares were around 9s. Burt Boulton were 26s. 9d.

Laporte Chemicals 5s. shares eased to 10s. 6d. although the market believed that in the expected new issue shareholders will be offered preferential terms of allotment, even if the issue is not confined exclusively to them.

British Glues 4s. units have been steadier at 22s. 6d. General Refractories (28s. 9d.) responded to the dividend increase, while elsewhere, Lever & Unilever have been at 46s. 3d. Associated Cement (91s. 9d.) have remained steady on market expectations that a higher dividend is in prospect. British Plaster Board 5s. units were 13s. 6d., and Goodlass Wall 10s. units 36s. 9d., but Pinchin Johnson eased to 37s. 6d. The 4s. units of the Distillers Co. at 20s. were easier although there is a reasonable possibility of a dividend increase, which, however, will again probably depend on the Budget. There has been some selling of United Molasses which came back to 56s. 3d.

Glaxo Laboratories at 60s. 6d. have been firm, helped by hopes of higher dividend prospects. Boots Drug at 48s. were little changed on balance. Turner & Newall were 89s., Dunlop Rubber 57s., and British Oxygen 94s. 4½d. Plastics shares were once more uncertain with British Xylonite at 80s., Kleemann 1s. shares 11s. 3d., British Industrial Plastic 2s. shares 6s. 4½d., and De La Rue 25s. 6d. Oils moved lower with Anglo-Iranian down to £5½ on the agitation for nationalisation of the Persian oil industry.

Market Reports

LONDON.—There is nothing of fresh importance to report on the industrial chemicals market and if there is a feature it is the steady demand for most items against an increasingly difficult supply position. Hopes of any improvement in sulphur supplies have received no encouragement nor has there been any noticeable easing in the container situation. Prices are firm throughout the markets and for many items only nominal quotations are given. Supplies in the coal tar products market continue tight and new business even for near forward delivery is difficult to place.

MANCHESTER.—From the point of view of contract deliveries and of actual new business in chemical and allied products active conditions have been reported on the Manchester market during the past week, both home consumers and shippers being prominent. The shortage of certain lines continues to grow more acute and is being reflected in increasing inconvenience to industrial users, including the textile trades. Prices are firm throughout. Fairly active conditions are reported in the market for fertiliser materials, while in the tar products section a brisk demand continues to be experienced for most of the leading light and heavy goods.

'British Plastics for the World'

The journal *British Plastics* has published a special 'British Plastics for the World' number. It contains a wealth of illustrated descriptive material covering many aspects of Britain's exports in plastics materials and products. In addition, it includes a special section giving advance details of the British Plastics Exhibition and Convention being held at Olympia, from 6-16 June.

The Lord President has appointed D. D. PRATT, O.B.E., Ph.D., Acting Director of the Chemical Research Laboratory, Teddington, to be Director of the Laboratory.

SIR ROBERT ROBINSON, O.M., F.R.S., has accepted the invitation of the Lord President to act as an honorary consultant on research in pure organic chemistry.

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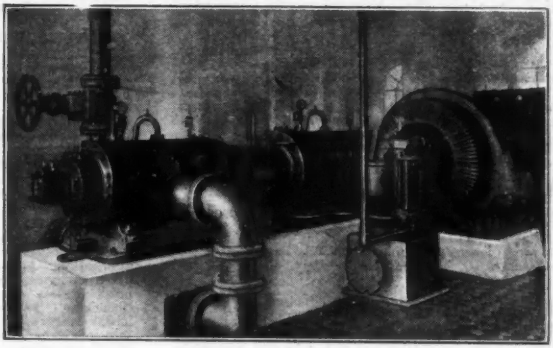

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PUBLIC APPOINTMENTS

NORTH WESTERN GAS BOARD, Liverpool Group, is prepared to receive applications from suitably qualified **ENGINEERS** or **CHEMISTS,** for appointments as **ASSISTANT WORKS ENGINEERS** (Grades £520/620, £570/670, £595/720, £645/770), or **PRINCIPAL CHEMISTS** (Grades £520/620, £570/670, £595/720) depending on qualifications. Applicants should be members of an appropriate professional body or possess a University degree together with experience in the fuel industries.

The appointments are subject to the conditions of service in the Gas Industry agreed from time to time by the National Joint Council for Gas Staffs.

The successful applicants may be required to pass a medical examination and to subscribe to such scheme of superannuation as the Board may adopt.

Applications, furnishing details of age, qualifications and experience, together with the names and addresses of two persons to whom reference may be made, should be forwarded to the Chief Personnel Officer, **NORTH WESTERN GAS BOARD,** Liverpool Group, Radiant House, Bold Street, Liverpool, 1, within 14 days of the issue of this advertisement.

SITUATIONS VACANT

AN excellent opening for a **SENIOR RESEARCH CHEMIST** occurs in an important chemical manufacturing organisation near London. A necessary qualification is a good chemical degree backed by research experience in the inorganic chemical, physico-chemical or allied fields and the ability to initiate and supervise research work. Problems related to heavy chemical production, pilot plant development, pure research and analysis are investigated. The position calls for resourcefulness, a capacity for hard work and an interest in experimental research work. Well equipped laboratories are available and future prospects are excellent. The appointment is pensionable and will carry a salary commensurate with qualifications and experience of the successful applicant. Applicants should give full particulars in strict confidence to Box No. C.A. 3002, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

ANALYTICAL CHEMIST, A.R.I.C, B.Sc., A.I.R.I., or equivalent required by well established Company in Croydon area. Pensions Scheme, canteen, Sports and Social Club. Applicants should be under 26. Commencing salary £450–£525 p.a., depending on qualifications and experience. Particulars to Box No. C.A. 2994, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

ANGLO-American Company producing cellulose for the chemical and allied industries, require a **QUALIFIED CHEMIST** for laboratory and process control work. Experience in our field not necessary. Age 20–30. Salary not less than £500. Applications, giving full details of education and qualifications to: CHIEF CHEMIST, The Holden Vale Manufacturing Company Limited, Haslingden, Lancashire.

CHEMICAL ENGINEER for design and construction of medium heavy air and gas treatment plants. Must be capable of direction and control of drawing office with full knowledge of detail construction methods and calculations in ferrous and non-ferrous metals. Small widely-known British Company of International Group, located in central London. Unlimited scope and excellent rewards for man with energy and initiative. Write Box No. C.A. 2998, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

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CHIEF TECHNICAL OFFICER required by well-known Meter and Instrument Manufacturer. Applicants must possess first class experience in instruments and light mechanism technology with academic knowledge of physics and mechanical engineering to degree standard. Post is permanent and pensionable. Salary range, £1,000 to £1,650 per annum, depending on qualifications. Only men of first class ability and experience will be considered. Applications in strictest confidence to Chairman, Box C.A. 694, at 191 Gresham House, E.C.2.

ENGINEERS with degrees in Mechanical or Chemical Engineering are required for The Bahrein Petroleum Company Ltd., Persian Gulf, who have openings for (*a*) men not over 40 years of age with three or more years experience in oil refining, coal tar or chemical distillation plants; (*b*) graduates with experience to train in various phases of their process, design and development work. Living costs are low the company providing free board, air conditioned accommodation and medical attention. Kit allowance, and provident fund. Write with full particulars of age, experience and education to Box 4035 c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.

PLANT DEVELOPMENT AND PROCESS ENGINEERS qualified in Chemical Engineering or Petroleum Refining Technology, required by Bahrein Petroleum Company, Limited. Age limit, 25-40. Two-year agreement periods with passages and paid leaves. Free air-conditioned accommodation, board and medical attention, kit allowance, low living costs. Salary according to experience. Write, with full particulars of age, education, experience, to **Box 3784, c/o Charles Barker & Sons, Ltd., 31, Budge Row London, E.C.4.**

RESEARCH CHEMIST required for electrochemical work, principally connected with nickel plating and allied processes, in the laboratories of a large light engineering firm in the Midlands. Applicants must have had sound chemical training and hold honours degree or its equivalent. Previous experience in this type of work will be considered a distinct advantage. Applicants should write stating age, experience, qualifications and salary required. Box No. C.A. 3003, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

SENIOR CHEMIST with a wide experience of analytical methods is required for work in connection with organic chemicals and subsidiary products based on petroleum. The work in the first instance will consist of the development of new methods of analysis and their application. Applicants must be capable and have had extensive experience of controlling and directing staff and must possess an Honours Degree or equivalent in Chemistry. The post is one of responsibility with an initial salary within £700-£800 per annum, and membership of a generous non-contributory staff assurance scheme is offered. Apply Box No. C.A. 2999, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

THE research laboratories of an expanding chemical manufacturer producing a commodity in growing demand, are increasing their permanent staff to cope with additional development and research work. Applications are invited from **GRADUATES** in inorganic or physical chemistry, who have a genuine liking for experimental research in the field of industrial inorganic chemistry. Previous industrial experience is not essential. Prospects are excellent. The commencing salary will be within the range £450-£650 depending upon qualifications and experience. Send full particulars in confidence. Box C.A. 3001, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4

SITUATIONS VACANT

THE Civil Service Commissioners invite applications for permanent appointments as **SENIOR SCIENTIFIC OFFICER** and **SCIENTIFIC OFFICER** to be filled by competitive interview during 1951. Interviews began in January and will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1951, may eventually be announced. Successful candidates may be appointed immediately. The posts are in various Government Departments and cover a wide range of Scientific research and development in most of the major fields of fundamental and applied science. Candidates must have obtained a university degree with first or second class honours in a scientific subject (including engineering) or in Mathematics, or an equivalent qualification, or possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years post-graduate or other approved experience. Candidates for Scientific Officer posts taking their degrees in 1951 may be admitted to compete before the result of their degree examination is known.

Age Limits: For Senior Scientific Officers, at least 26 and under 31 on 1st August, 1951; for Scientific Officers, at least 21 and under 28 (or under 31 for established civil servants of the Experimental Officer class) on 1st August, 1951. Salary Scales for men in London, Senior Scientific Officers, £700×25–£900; Scientific Officers, £400×25–£650. Rates for women are somewhat lower.

Further particulars from the Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. 3399.
10226/250/MLB

YOUNG ENGINEER with degree standard in Mechanical or Chemical Engineering required as junior assistant by leading Chemical Engineering firm for heat transfer calculations and similar technical work. Permanent and progressive appointment with varied experience offered. Residence in London area necessary. Write stating age, experience and salary expected. Box No. C.A. 2997, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

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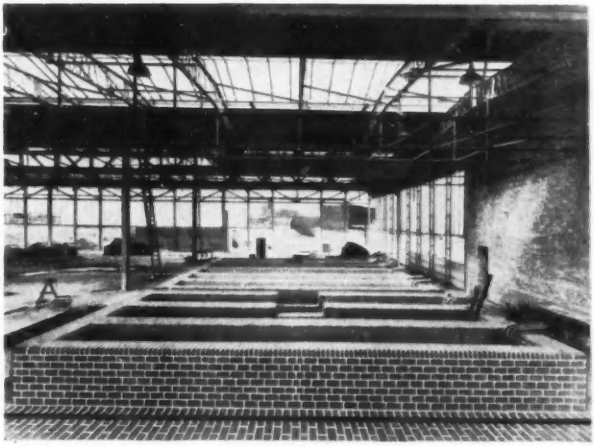

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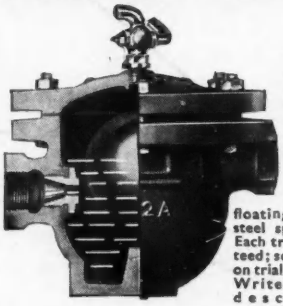

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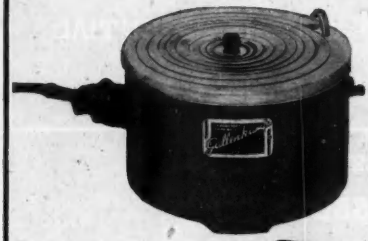

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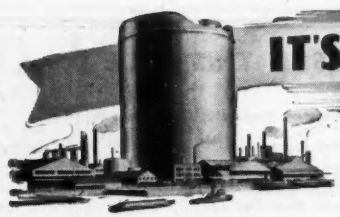

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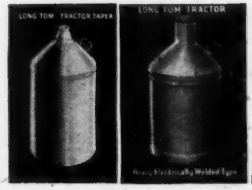

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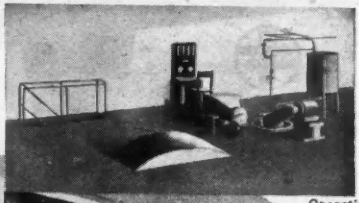

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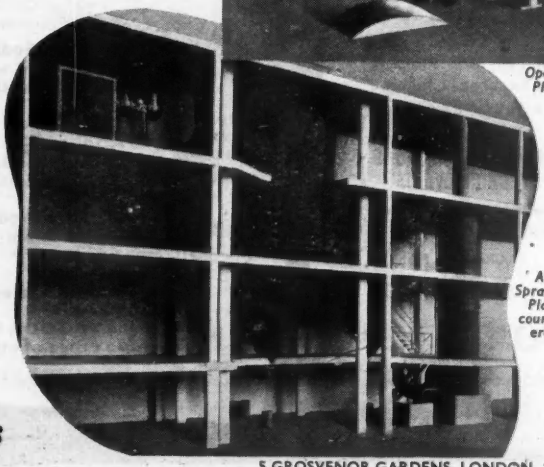

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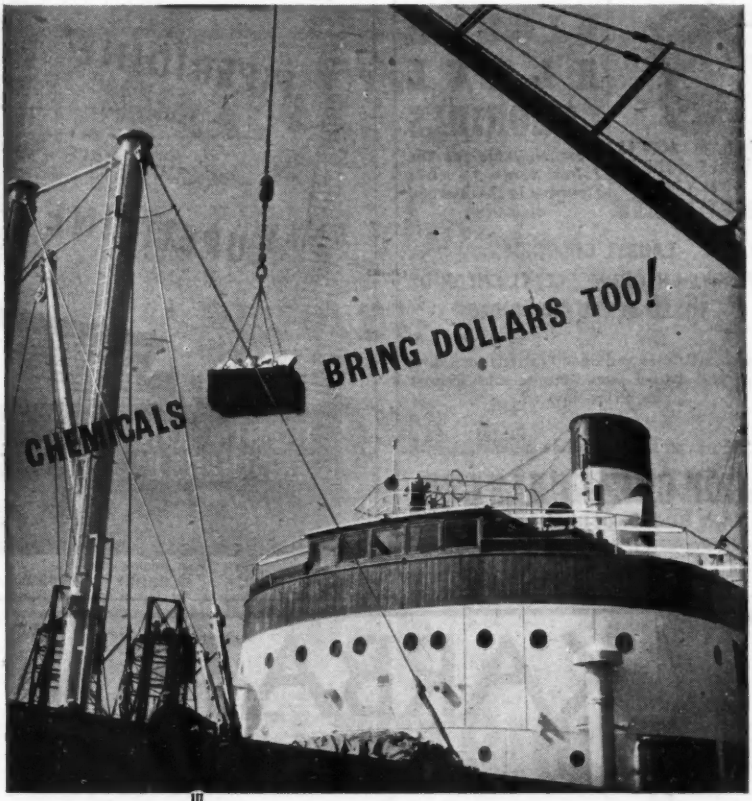

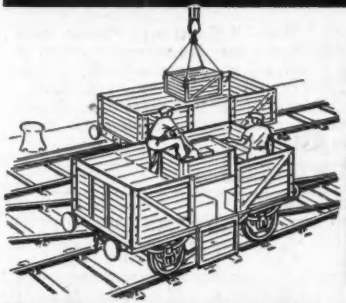

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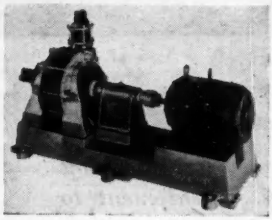

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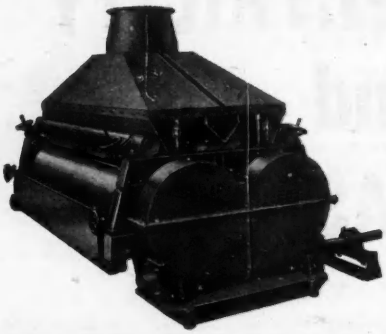

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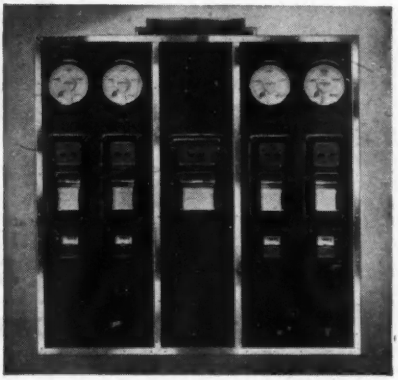

Evershed Recorder Panel for distant indication and recording of electrical loads in a modern film studio.

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Volume LXIV 24 March 1951 Number 1654

Chemicals in the Swim

A VERY small boy recently made a masterly addition to our national collection of howlers by defining water as a white liquid that goes dark when you wash it. It is to be hoped that his powers of clear observation will not be discouraged for it is often a failing of such adults as politicians, let alone of small boys, to confuse causes and their effects. Moreover, this definition is not far removed, at any rate spiritually, from one aspect of water to which the Ministry of Health has just devoted a new publication, 'The Purification of the Water of Swimming Baths' (H.M.S.O., March, 1951, *pp.* 36, 1s. 6d.). The problem of swimming bath water is that it inevitably increases its contents of undesirable substances including bacteria when people swim in it. It is, however, very easy to exaggerate the infective dangers of the public swimming bath, particularly today, when we are sadly witnessing annual increases in the attacks of poliomyelitis (infantile paralysis). Attention might well be drawn to the clear statement in this report that the balance of evidence is in favour of keeping open *properly controlled* baths and pools even at times when 'polio' is unusually prevalent.

The confidence with which modern baths may be regarded rests largely upon chemicals. It might be said that water clarity is maintained by continuous filtration, but even here chemicals have long been supplements for the mechanical operation. Aluminium sulphate is used as a coagulant and a de-colouriser. A certain alkalinity must be present so that the flocculent and filter-aiding aluminium hydroxide is precipitated. Most hard waters are sufficiently alkaline, but soft waters require small additions of lime or soda. The frequent *p*H checking of the water is, in fact, an important duty of baths superintendent staff, for the use of both aluminium sulphate and chlorine builds up acidity, but addition of lime or soda must be carefully regulated, as a *p*H above 8.0 may cause eye-smarting. The *p*H range must be 7.2 to 8.0 to prevent troubles on either side.

Although filtration through sand, when aided by alumina-precipitants, will remove some bacteria, this process, even when followed by forced aeration, cannot deal with all bacteria and it cannot make dissolved pollution harmless. The 'safety' of the water depends upon chemical sterilisation and the chemical used must possess a 'residual' activity to deal with further pollution, while the water is being used. Chlorine would seem unchallenged in British experience, being relatively cheap, not difficult to add in controlled dosage, quickly

bactericidal, and possessing good residual activity. Nevertheless, efficient chlorination is not the simple operation that many chemists might suppose.

Chlorination must be continuous, for it is constantly lost by reaction with polluting substances and volatilisation. Intermittent doses sufficiently high to give long-period protection would be objectionable in odour and effect upon the eyes. A far from simple chemical problem arises from the interaction of chlorine and ammonia, a common natural or polluting substance in swimming bath water. Chloramines are formed and although these substances are also bactericidal they are much less efficient than chlorine; but the older tests for estimating the content of free chlorine did not distinguish between truly free chlorine and the chlorine in chloramines. This can give a somewhat false sense of security for the chloramines are more stable. Thus, a build-up of residual chlorine as chloramines may occur, partly because chloramines are slow to react with polluting material and partly through their natural stability. To overcome this, the practice of 'breakdown chlorination' is sometimes adopted, and certainly should be whenever there are reasons to fear greater infective risks. This modern method is based upon the fact that chloramines are unstable in the presence of excess chlorine, breaking down into hydrochloric acid and nitrogen. Breakpoint chlorination is today widely employed in the United States. It needs more chlorine and greater skill in operation. It requires acceptance of a higher upper limit for 'residual chlorine' content, probably 1 to 2 parts per million, as against the former standard of 0.5 p.p.m. Nevertheless it does ensure that the residual chlorine is indeed chlorine whereas much of the 0.5 p.p.m. content under the older system may be the less effective chlorine of chloramines. It is stated in the Report that a content of several p.p.m. of free chlorine must be reached before irritation of eyes and nose or pungent odour is experienced by bathers; though much smaller amounts of nitrogen trichloride are more troublesome and there is perhaps some risk of this saturated chloramine being produced in breakpoint chlorination.

It is clear that chemical intervention is not yet completed. A simple and rapid test for distinguishing between free residual chlorine and chloramine is still required; however, the ortho-tolidine test gives a qualitative distinction inasmuch as the initial colour shown is due to free chlorine only; a poor colour produced immediately would show that the free chlorine content was low even though the colour developing later was powerfully yellow. Or sodium arsenite may be added, thus reducing the chloramines and

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Notes & Comments

Magnesium and War

NO metal seems more sensitive to war fears or conditions than magnesium. Germany first founded the magnesium industry in the late nineteen-eighties but her leadership in this branch of metallurgy did not prove to be of great advantage in the first war. Well before the second, both America and Canada had established substantial magnesium industries; Britain followed suit during the war. An idea of the relationship between modern war and magnesium is given by American figures. In 1939 total production was 6.7 million pounds. During the second war, production reached an annual capacity of 586 million pounds, almost a 90-fold increase. There followed a severe post-war decline though demand did not drop back to the pre-war level. The commercial or strictly peacetime demand for magnesium in 1949 was 38 million pounds and a probable figure of 5 or 6 million pounds for military requirements can be estimated. A similar pattern was followed from 1919 onwards. During the first war there were five American producers; by 1920 only two; and by 1927 only one, the Dow Chemical Company. Nevertheless, if the spectacular war-induced additions to demand are removed from the magnesium statistics since 1915, steady development is shown. The huge peak of War II, with 80 per cent of the demand going to the aircraft industry, tends to conceal this.

Shortage only Temporary

THE re-armament programme will inevitably lay another abnormal peak upon the upward graph of magnesium use. Unlike some of the other non-ferrous metals, however, magnesium is not likely to be persistently scarce. There are virtually no limits to the quantity of materials from which the metal can be extracted, notably to the sea in which there is 0.14 per cent of magnesium or 4 million tons per cubic mile; and there are many magnesium-containing minerals. There is at present some shortage but it is likely to be quickly corrected by the re-opening of closed wartime production capacity. A new factor in the demand for magnesium is the increasing use of zirconium and titanium; for the production of these rarer elements magnesium is the usual reducing agent. Broadly, therefore, every extra ton of these metals that is required also requires an extra ton of magnesium.

Photosynthetic Progress ?

IT is as well to remember now and then in this atomic age that the primary chemical reaction of Nature —the photosynthetic fixation of carbon dioxide by plants—is still largely unexplained and certainly inimitable by man. Though studied for many decades, this universal process of the back-garden and the jungle is still the biggest of all challenges to modern science. Joint German and American research at the Kaiser Wilhelm Institut, Berlin, may have made fundamental progress in this direction. Although scientific papers have yet to appear, advance reports indicate that it is now understood how only one quantum of light can initiate a process that in fact is known to require three times that amount of energy. It would seem that an unidentified substance in plants will join with one molecule of carbon dioxide when one quantum is absorbed. At the same time one molecule of oxygen is liberated. In darkness later two-thirds of the energy that has been absorbed is used in a combustion reaction that absorbs oxygen and produces carbon dioxide. In this process energy is released and it is that amount of energy which is of fundamental importance to the photosynthetic process as a whole.

Enormous Possibilities

HOWEVER, the simple one-quantum stimulated reaction and its partial reversal in the dark form a chain process; when repeated three times this pair of reactions absorbs the amount of energy previously found (in

1949) to be the total amount required for the synthesis of one molecule of carbohydrate. The fact that an unknown substance is concerned in this opens out enormous possibilities. If it can be identified, far greater advances than the development of atomic energy may be within sight. The leader in this research is Professor Otto Warburg, the German Nobel prizewinner. Dr. Burk, U.S. scientist, has been associated with recent developments. It should be pointed out, however, that this account is based only upon brief press-released material and not upon detailed scientific papers.

Colds and Antihistamines

LAST autumn the Medical Research Council reported with vigorous unfavourability upon the claims of antihistamine drugs as cures for the common cold. Small and large tests had shown that three of these drugs were valueless either in the prevention or treatment of colds. This verdict has not been as damaging to the boom in antihistamine 'cold cures' in America, their home country, as might have been expected. A current chemical trade journal reports that turnover in these drugs—sold as cold remedies—is in the region of $100 million per year. This winter 'millions of Americans have popped tablets in their mouths at the first sniffle or sneeze.' The situation, viewed as an Anglo-American comparison, is remarkable and perhaps unique. Is faith the actual cold-alleviating influence? And to what extent has high-pressure advertising created public faith?

Boom on the Wane

THERE are gradual signs, however, that the American boom is on the wane. The Food and Drug Administration has intervened with restrictions upon certain advertising claims and the medical research workers are producing test statistics whose trend is towards the British verdict of 1950. In the largest British experiment 1,550 volunteers were given either an antihistamine (thonzylamine) or a sugar pill treatment; the differences in the response of cold sufferers were insignificant. Similarly at Boston University 1,214 volunteers were divided into four groups and given three different antihistamines or a sugar pill. The analysis of the results led to the conclusion that it was impossible to distinguish any effect of the antihistamines 'that differed significantly' from the blank or control treatment. There would thus seem to be considerable agreement between American and British medical science in this other kind of 'cold war.'

CHEMICALS IN THE SWIM

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preventing them from influencing the colour change at all.

Chlorine may be added as bleaching powder in solution, as liquids containing high concentrations of chlorine, or as gas. The use of the gas is now favoured since the dosage rate is the more easily controlled. The point of introduction is generally after filtration. There seems some controversy whether it should precede or follow aeration, a strange point upon which the Report gives no enlightening details. In addition to its main bactericidal function, chlorine prevents the growth of green algæ on the sides and bottoms of baths or pools, a contribution that is not merely æsthetic, for several fatal accidents have resulted from algæ accumulations.

No mention is made in the Report of the use of bromine instead of chlorine though this sister-halogen is sometimes preferred in America, where it is said to have longer residual stability, less risk of causing irritation and odour objections, and to be easier to introduce at a controlled rate. Bromination made considerable headway in America during the war when chlorine was scarce (*Chem. Industries*, 1949, *65*, 5, 712). However, with chlorine and perhaps bromine one day, it is satisfying to realise that the only contribution of the modern chemist to the pleasures of swimming is not that perhaps apocryphal story of the post-war synthetic bathing costume that dissolved in the deep end. Thanks to chemistry our swimming baths have made great progress in both visible and invisible cleanliness since the days of the nineteenth century weekly 'fill and empty' system.

Spray-Drying Synthetic Detergents

Paper Read at Institute of Fuel Meeting

AT a meeting of the north-western section of the Institute of Fuel on 15 March, Mr. M. W. Smith, B.Sc., A.M.I.Chem.E., of the Shell Petroleum Company, read a paper on 'Spray-Drying Synthetic Detergents.' Household synthetic detergent products, he said, are made either by hot spraying or spray-cooling, the physical form of the dried products depending on their end uses. The general principles underlying spray-drying, whereby a solution or slurry of the material to be dried is sprayed into a stream of hot drying air, producing a dry granular product which can be recovered as such without further processing, had been described in an earlier paper. The present paper dealt specifically with the spray-drying of synthetic detergents of the type used for dish-washing, laundering and general cleaning in the household.

Mr. Smith's paper was as follows:—

There are two major types of spray-dried household synthetic detergent products. Firstly, the fine wash products for dish-washing, laundering of woollens, silks, rayons and nylon and for general cleaning applications such as washing of paint, woodwork and floors. With these are the all-purpose products which, as the name implies, are suitable for all household applications, including the laundering of cottons. In addition there are the unbuilt high active-content base detergents for marketing as such, for dry blending with alkaline builders. All these products are made by hot spraying.

Spray-Drying Equipment

There are also the spray-cooled products made on spray-drying equipment, the process being similar to spray-drying with the exception that cold air is used in place of hot. In this latter process little water is evaporated, the solid form being obtained by the crystallisation of the water with sodium carbonate. The products have low active detergent contents and high sodium carbonate contents and therefore have limited application.

The particular requirements of spray-dried synthetic detergents for these end uses are large uniform particles, sneeze-free and therefore free from dust, of sufficient mechanical strength to prevent breakdown in the packets and free flowing; the absence of lumping or tendency to lump on storage or when the packet is opened in a humid atmosphere, of the required bulk density, of good odour and colour and rapidly soluble in both hot and cold water.

Three Types of Atomisers

There are several different types of spray-drying equipment broadly classified according to the method used for atomisation:—

1. Spinning disc or centrifugal atomisers;
2. High pressure jet atomisers;
3. Two-fluid nozzle atomisers.

In general the first two form hollow spherical beadlike particles and the third, irregular and denser particles, but any type may produce a product of varying form and density depending on atomiser design, operation and characteristics of the feed.

The first category has two varieties of atomiser unit. The overdriven plants, where the disc and inlet for hot air are at the top of the chamber, so that the particles and drying air are in parallel or concurrent flow, and the underdriven plants where the disc and hot air inlet are near the base of the chamber. In this latter case the particles and drying air are partly in parallel and partly in countercurrent flow. In both types the product is withdrawn from the bottom of the chamber.

It will be seen that in the case of the underdriven plants where the products fall through the hot inlet air stream, a more anhydrous product can be obtained than on the overdriven plants where the finished product is in direct contact with the humid outlet air. However, when drying synthetic detergents, as distinct from certain other materials, this is no disadvantage, and as will be seen later the efficiencies and capacities of overdriven plants are higher than those of corresponding underdriven plants.

The diameter of the chamber governs to some extent the maximum size of particle which can be produced without a build up on the walls, since the larger the particle the greater its momentum and therefore the greater the time and distance required in which to dry it. Since large particles are a major requirement of household synthetic

detergents the larger diameter plants give the more acceptable products.

The greatest single factor controlling the size and uniformity of the particle is the speed of the disc. In general spinning discs when running at high speeds produce very uniform, although fine particles. As the speed is reduced the particle size increases and the uniformity decreases until at a critical minimum speed, which depends upon the type of feed and disc; atomisation ceases and streams of liquid are thrown off the disc which do not break up into particles and therefore do not dry out before touching the walls.

Spinning Discs

There are several kinds of spinning disc. The simplest is a flat or bowl-shaped smooth disc so that the feed is flung from the edge as a continuous sheet. Other types have varying numbers of radial vanes, nozzles, or apertures so that the feed emerges as a number of streams. The sheet or streams then break up into spherical particles.

The uniformity of the spray is of the utmost importance, since the capacity of the dryer is governed to a large extent by the time required to dry the largest of the drops formed. With a non-uniform spray at normal feed rates, the largest drops tend to be incompletely dried, forming wet lumps in the product, making it necessary to reduce the rate of liquid feed. It will therefore be obvious that the more uniform the spray the greater the capacity of the dryer.

The feed is prepared in the mixing tank, care being taken to ensure that the solid ingredients are finely ground and evenly dispersed. The temperature of the feed may vary from about 50°C. up to almost 100°C. depending on the type of feed and other operating conditions. The most important characteristic of the feed is the solids content, since it has a major effect on the properties of the finished product. In general, slurry feeds are employed at solids contents of from 50 per cent to 70 per cent.

High inlet air temperatures are necessary for maximum output, to produce large size particles and to ensure complete drying before the particles touch the walls. There is, however, an upper limit to this temperature set by the heat stability of the product. In addition, the higher the temperature the greater the puffing-up effect giving thinner walled particles with greater fragility and lower bulk density. The optimum inlet air temperature for the majority of overdriven spinning disc plants is within the range of 250°C. to 300°C. with corresponding outlet air temperatures of 110°C. to 180°C. respectively.

Whereas in the case of the overdriven plants only the wet material comes into contact with the hot inlet air, on underdriven plants it is the dried product which falls through the inlet air stream, and therefore underdriven plants require slightly lower inlet air temperatures. Furthermore, the outlet air temperature on underdriven plants must be relatively higher than on overdriven plants, because the initial drying is by the air leaving the chamber, the temperature of which must be high enough to ensure almost complete drying of the particles before they reach the walls. Again, the actual temperatures vary according to the type of product and plant, but typical figures would be of the order of 240°C. inlet and 130°C. outlet.

Air heating may be by means of steam, electricity or oil, either indirect or direct. In the case of the latter, care is necessary to avoid particles of soot in the powder.

The product offtake should be of a type to give the minimum mechanical agitation reducing the tendency of the fragile beads to break down to dust. A rotary valve offtake with pneumatic conveyor leading to low velocity cyclones at the packaging point is an ideal system.

Any of the recognised methods of dust filtration may be used for screening the dust from the outlet air. In the case of the better products the dust is used for feed make-up, for blending into scouring powders and cheap cleaners and not mixed in with the product from the chamber.

High Pressure Jet Plants

As in the case of the spinning disc plants, there are a number of different types of high pressure jet plants. Many are essentially similar to the spinning disc plants with a single high pressure jet in place of the disc. Others are of the same type as the soap powder towers with improved air heating. This latter type with countercurrent air and feed flows, where the jet and air outlet are situated at the top of a high tower with the air inlet at the bottom, are preferred by many manufacturers for spray-drying synthetic detergents, since greater inputs are possible, giving larger particles and less filter fines than the spinning disc plants.

With the jet or jets directed vertically down the tower and not towards the walls, relatively large particles can be produced with less risk of them touching the walls before they have dried out. Furthermore, a large proportion of the dried dust particles carried up the tower by the ascending air stream adhere to the particles of freshly atomised material in the jet zone, forming agglomerates, thereby increasing the average particle size and decreasing the amount of dust in the filters.

Since with countercurrent flow the freshly atomised material is in contact with the low temperature outlet air, the puffing-up of the particles is less than in the case of the overdriven spinning disc plants. Because of this and since agglomerates are formed, it is possible to obtain higher bulk densities than on the spinning disc plants with the same particle size and uniformity.

In the case of the spinning disc chambers ample width is necessary owing to the initial horizontal path of the particles. The diameter of the chamber is therefore approximately equal to the height. The height of the pressure jet towers, however, with the spray directed vertically downwards towards the centre of the tower from the upper periphery is usually about three times the diameter. The major factor controlling particle size and uniformity is the pressure at the jet. At high pressures uniform small particles are produced, and as the pressure is reduced the particle size increases but the uniformity decreases.

Since the particles and air are in countercurrent flow, in order to minimise scorching of the product, lower inlet air temperatures than are used on parallel flow plants are necessary. The permissible inlet temperature depends to a large extent on the type of product being dried. In general it is within the range of 150°C. to 220°C. with corresponding outlet temperature of 80°C. to 120°C. Product collection and dust filtration are the same as for the spinning disc plants.

Two-Fluid Nozzle Plants

Two-fluid nozzle plants are mainly used for spray-cooling soap powders with cold air, since a single nozzle has a large capacity, requires little maintenance, will atomise very viscous feeds and will produce large particles although of a non-uniform size. Furthermore, compared with spinning disc and high pressure jet plants the feeding and atomising mechanism is relatively inexpensive. They are, however, not frequently used for spray-drying synthetic detergents, since, owing to the irregular particle size, especially in the larger particle range, it is difficult to obtain a thoroughly dried product without scorching. In addition there is usually a high proportion of fines. Moreover, whereas spinning discs and pressure jets are film-forming atomisers, two-fluid nozzles are filament or thread forming. Because of this they less readily form hollow beads and therefore tend to give heavier particles. The plants themselves can be either the parallel flow or countercurrent flow type with one or more two-fluid nozzles in place of the spinning disc or pressure jet atomisers.

Once optimum operating conditions have been established for any individual dryer, product form and composition, etc., the plant is controlled by the outlet air temperature. Any increase in this temperature above the optimum indicates a decrease in feed rate resulting in a reduced input and possibility of scorching the product. A decrease in outlet temperature indicates an increase in feed rate resulting in a damp product.

Automatic Control

Since spray-drying is a continuous process, the most economical method of operation is on a 24-hour basis. Many units are fully automatic, the feed valve being thermostatically controlled by the outlet air temperature so that any minor fluctuations in the feed rate are corrected by the subsequent changes in the outlet air temperature. Where for some reason or other there are sudden and appreciable variations in the feed rate, the time lag before they become evident in the outlet air temperature may be too great to permit accurate control, when manual operation becomes necessary. On spinning disc plants the current required to drive the disc, measured by an ammeter in the circuit, is a useful guide to the feed rate.

The overall thermal efficiency depends to a large extent on the temperature drop through the plant. Taking typical inlet and outlet air temperatures for overdriven disc plants as 250°C. to 110°C. (*i.e.*, a drop of 140°C.), for underdriven disc plants of 240°C. to 130°C. (*i.e.*, a drop of 110°C.) and for countercurrent high pressure jet plants of 150°C to 80°C. (*i.e.*, a drop of 70°C.) the

theoretical thermal efficiencies based on the heat lost in the outlet air are 61, 50 and 54 per cent respectively, assuming that the air is heated from an initial temperature of 20°C.

It will therefore be seen that it is most economical to operate at as high an inlet and as low an outlet temperature as possible. However, as pointed out above, these two temperatures are limited by the type of plant, the form and composition of the product.

In addition to the heat lost in the outlet air, radiation losses can be appreciable. The overall thermal efficiency is therefore substantially lower than the above efficiencies, based on the heat lost in the outlet air, indicate.

The water evaporation capacity is governed by the drop in temperature through the plant and the volume of air flowing. It has been seen that for optimum operation on any particular plant and product the drop in temperature is more or less fixed. There is also an optimum for the air flow through the plant, which for the majority is at the rate of 0.3-0.4 cubic metres of hot air per second. Above this range the increased turbulence may cause a greater proportion of the product to stick to the walls and an increase in the carry-over of solid material to the dust filters, and below this range the capacity will be unnecessarily low.

Since the outlet air will be far from its saturation point it would be expected that economies could be effected by recovering the waste heat. Heat exchangers for preheating the cold inlet air or feed are not common. In some of the larger installations, however, part of the filtered air is recirculated with the fresh air.

In the case of the spinning disc plants the trend is to wide diameters and low disc speeds with high inlet air temperatures requiring a fired heater. With the countercurrent pressure jet plants the trend is to tall towers and higher inlet air temperatures. With all types, product offtakes should be designed for rapid cooling of product and minimum mechanical agitation.

Further research is necessary on spinning disc plants to give larger and more uniform particles at higher bulk densities and at higher inputs without build-up on the walls.

It would also be useful to have a knowledge of drying time as a function of particle size, air temperature and air humidity.

Molten Metal Dyeing

Ciba Expert Explains Process

ON 17 February, Dr. Charles J. Weidmann, manager of the technical department, Ciba Company, Ltd., revealed for the first time in North America the technical details of the 'Standfast Molten Metal Dyeing Process.'

Dr. Weidmann addressed the regular monthly meeting of the Canadian Association of Textile Colourists and Chemists, Quebec Section, at McGill University. He pointed out that the tremendous interest created by the molten metal process was due to its utter simplicity of operation, which made it approach very closely indeed 'the ideal dyeing method which should be such as to allow us to colour the cloth or material we are dealing with uniformly, at a low cost, and in the shortest possible time.'

How It Works

Describing the Standfast method, Dr. Weidmann explained how 'the material enters the machine from a loading wagon, is preheated by passing over a series of steam cans, goes through the dye liquor into a large U-shaped unit containing the molten metal.' This U-shaped unit was the unique part of this new dyeing unit, he said. It was filled with 'a combination of bismuth, cadmium, tin and lead, having a melting point of around 160°F. and a density of around 9.

Listing the many advantages of the process, Dr. Weidmann said that 'the molten metal acts in a double capacity: first, as a medium of heat transfer, and secondly, as a unique means of applying pressure to the fabric. It accomplishes both these tasks with an efficiency not previously met in any textile operation. Beside the uniform pressure which the metal exerts, we also have the exclusion of air, preventing oxidation and eliminating all the defects which it can cause.' Furthermore, with dyeing temperature only 203°F., all vat colours could be used. Dr. Weidmann claimed that 'for the first time we are able to dye the fibre before the vat colour has sufficient time to break down under the high temperature.' Another feature was the speed with which a new shade could be put on. 'The time elapsed to effect a complete changeover from a full black to a baby pink would average about five minutes,' he said.

MIDLANDS ANALYTICAL METHODS DISCUSSION GROUP

Problems in Steel Analysis

RECENT years have seen the solution o many of the difficulties encountered in the analysis of steels, but a number of long-standing problems still exist. Some of the more important of these were described and the work being directed towards their solution outlined by Mr. B. Bagshawe, of the Brown-Firth Research Laboratories, Sheffield, speaking at the sixth meeting of the Midlands Analytical Methods Discussion Group held recently in Birmingham.

A practical solution is still awaited to the problem of operating the combustion sulphur process on a stoichiometric basis. Such a solution would be a most important development, as other sulphur determination methods are open to question. Methods based on hydrogen sulphide evolution are becoming more restricted in scope and use. Serious discrepancies arise on certain types of alloy steel, for example, copper and molybdenum steels, and the yield is also affected to some extent by the nature of the sulphur constituents in the metal, and the conditions of heat treatment.

The classical barium sulphate gravimetric procedure is open to error; in very low sulphur ranges, for instance, recovery is almost invariably incomplete. Various devices have been used to encourage maximum recovery, such as addition of known amounts of standard sulphate solution, but these have not been entirely successful. The process also suffers from inconsistency of blank values, which are often of comparable magnitude to the amounts of sulphur being determined.

Combustion Process Best

When much chromium is present the barium sulphate process is practically useless, due to the formation of complex chromo-sulphuric ions which are not precipitated by the barium ion. Complexing of the chromium with acetic acid or other complexing reagents may help in this direction. Oxidation of chromium to chromate will precipitate insoluble barium chromate.

The combustion process and its properly regulated operation is really the key to the solution. Its many attractive features include speed, convenience of manipulation, and, above all, the fact that it may be applied to the widest range of steels and ferro-alloys. If only the problem of the yield factor could be solved, then there is no doubt that, as far as steel is concerned, all other methods would be abandoned forthwith.

In the most recent form of combustion apparatus soda asbestos is replaced by a silica gel dryer. A rubber suction ball is also incorporated to permit the absorbent to be drawn up the delivery tube for rinsing purposes, giving an increased titre of 0.2-0.3 ml. Other developments include the use of enclosed cartridge-type boats, which permit a more concentrated reaction with less slag spatter.

Modern Improvements

Elimination of all filters and plugs of cotton wool, asbestos, or glass wool, and the simplification of the delivery part of the system are important recent trends. These modifications are possible, since the carry-over of ferric oxide dust can be prevented by presintering the sample before admitting oxygen.

Sintering for periods of two to five minutes is most effective, and the ferric oxide dust is retained in the hot combustion zone, where it is not likely to hold or fix sulphur. The deposition of iron oxide in colder parts of the system, as would otherwise occur, is likely to fix and retain sulphur gases, and thus markedly affect the yield; this deposition is one of the causes of progressive yield drop during the life of a tube, the yield showing a maximum with a perfectly clean new system and slowly falling as the tube becomes fouled with slag and oxide adhesions.

Use of a refractory plug in the furnace is a great help in retaining ferric oxide dust in cast iron sulphur determinations. The combustion boat must be more than 1 in. from the plug, otherwise molten ferric oxide causes choking.

One of the probable causes of low sulphur recoveries is that some of the sulphur trioxide formed may pass through the absorption system as an unabsorbable mist.

Carbon determinations have not presented any real difficulties for some time as all

general needs have been met by the dry combustion procedure. Modern developments in the production of super-pure iron and 4 per cent silicon iron, where carbon contents exceeding 0.01 per cent become of critical metallurgical importance, have served to emphasise the deficiencies of this conventional procedure for these specialised needs.

To a lesser extent this is also true of the Special Steel Industry where carbon specifications of 0.03 per cent (max.) are being laid down for certain classes of stainless iron and steel. As a result, carbon determinations expressed to the third and fourth decimal place are being demanded.

Combustion Process Modified

An attempt has been made to meet the present urgency as far as low carbon stainless steel is involved, at the Brown-Firth Laboratories by developing a scaled-up version of the normal combustion process. Carbon combustions are at present being carried out on 16.362 g. of stainless steel, which amount is six times the normal factor weight of 2.727.

The conventional apparatus has a reproducibility level of about ± 0.01 per cent. For work in low ranges the process is too much affected by blank variation, and errors are incurred due to computing small weight differences from weighings of large mass, for example, absorption bulk 100-120 g.

A large tube 30 in. long with an internal diameter of 1½ in. and operating at 1,200°-1,300°C. is used in the scaled-up combustion system. The boats are of large size (4¾ in. by 1¼ in. by ¾ in.) and accommodate the full charge of 16.362 g. of steel drillings or millings. The boats are pre-ignited at 1,200°C. before use, and give a residual blank of only 0.0004 g.

The absorption system includes an outsize Arnold bulb, containing chromic-sulphuric acid to absorb sulphur gases, but the CO_2 absorption bulb of Midvale pattern is of specially small design, 4 in. by ¾ in. so that its total weight when packed with soda asbestos is only about 30 g. Combustion under these conditons is steady and placid, and the exothermic heat from such a large charges ensures the complete fluxing of the whole mixture. The flux is 7 g. of red lead, pre-ignited before use at 450°C.; after this treatment the red lead blank does not exceed 0.0003 g.

Total blank in the process is only about 0.7 mg., and the carbon equivalent of this on a 6 x factor weight charge is only 0.0012 per cent carbon. Reproducibility is easily maintained at ± 0.002 per cent for routine operation of large batches.

Other possibilities for development are conductimetric measurements after absorption in barium hydroxide, and the development of radio frequency or induction combustion units.

For research purposes, determinations in the fourth place, for example ± 0.0002 per cent, can be obtained by refined methods of measurement, such as the low pressure method in which the CO_2 evolved by combustion is trapped by freezing in liquid oxygen and then released in a vacuum system, where it is collected and evaluated manometrically.

Determination of carbon in steels by the copper-potassium chloride method, while not obsolete, is not entirely satisfactory, as recovery of both elements is incomplete. Again, the procedure of dissolving the steel sample in copper-potassium chloride solution is too time-consuming to be of use in routine steel analysis.

Estimation of Tin

The most common method for determining tin consists of reducing it in the steel solution, either directly or after a separation as sulphide, the reduction being effected with a metallic reductant; the reduced tin is then titrated with standard iodine or iodate.

Metallic reductants for tin include antimony, aluminium, nickel, lead and iron, but the bone of contention at the present time is the relative merits of the antimony-aluminium and nickel reduction procedures. By antimony-aluminium reduction is meant reduction with aluminium metal in presence of a dissolved antimony salt. This is rather a different case from metallic antimony reduction which has been rejected by Evans and other workers.

Objection to antimony is that the titration accuracy is a critical function of antimony particle size; a coarse antimony gives low results due to incomplete reduction, and a finely ground flour gives high results due to reaction with iodine. Thus, high or low results may be obtained at will, merely by altering the grading of the antimony flour, and correct results are mainly a matter of chance.

By using a combination of aluminium metal with an antimony salt in solution,

metallic antimony is precipitated in solution in the form of a sponge of uniform characteristics, and it is possible to control the reduction so that only a slight excess of antimony metal persists through the boiling interval for reduction.

Evans has reported that as much as 8-9 per cent of the tin present may be lost in the antimony residues, although this is not the case for the very small amounts of tin involved in steel analysis; indeed, proved and tested methods have been put forward in turn for plain and low alloy steels, for highly alloyed steels and finally for ferrotungsten, by official BISRA committees, and approved by BSI.

In spite of this, however, the anti-antimony pro-nickel school has many adherents. The experience of the industry subcommittee, which carried out the tin investigations, was that nickel reduction (using an etched and activated spiral) was relatively slow, and that the reduction was often uncertain and incomplete if the spiral was not properly activated by etching in strong salt solution. Another point was that the green colour of the solution of dissolved nickel salts impaired the sensitivity of the end-point.

Cobalt Determination

An improved method for determining substantial percentages of cobalt is required. The nitroso R salt absorptiometric procedure is easily the best available, but it is best adapted to a moderate range of cobalt content, and, in order to extend its use over the wider range required, semi-micro fractions must be used.

The classical gravimetric procedures are few in number, restricted in scope, tedious in operation and poor in performance. The α-nitroso-β-naphthol method, for example, is completely unselective. Residual unremoved iron and chromium, and also copper, are precipitated with the reagent. Finally, the cobalt residue is of uncertain composition, and the ignition product, while weighed as Co_3O_4, often contains CoO.

Precipitations as cobalt sulphide are not possible if nickel is present; again, the ignition product is of doubtful composition and may contain residual sulphur compounds. such as $CoSO_4$.

Electrometric titration with potassium ferrocyanide in ammoniacal citrate medium is probably the best alternative to the nitroso R salt procedure. Some workers claim satisfactory results in the analysis of Kovar-type materials (Ni, 30 per cent; Co, 17-18 per cent), although the process requires empirical calibration and for certain steels involves a rather doubtful manganese correction.

The dimethylglyoxime reaction, with or without cyanometric titration, meets most requirements for nickel determinations, but the most pressing need is for a good separation from cobalt. Cobalt interferes in glyoxime precipitations, contaminates the precipitate and may cause partial suppression of precipitation; interference is controlled by oxidation with hydrogen peroxide to the cobaltic state, but this fails when the cobalt/nickel ratio is unfavourably high, with the result that determinations of small amounts of nickel in high cobalt steels are uncertain and unreliable.

With Kovar-type materials, the cobalt contamination problem is acute. X-ray examination shows that the precipitate consists of two phases—the nickel dimethylglyoxime complex and an iron-cobalt complex. This, however, only occurs when the iron is present in its higher valency state. A complete separation can be effected if the iron is first reduced to the ferrous state with sulphite.

Copper interferes to a lesser extent. Thus, large amounts cause partial inhibition of the nickel reaction, and large amounts of glyoxime reagent must be added, while contamination of the precipitate with copper occurs at quite low copper concentrations, and this necessitates repetitive treatments.

Baron Determination

Determination of traces of boron, for example, 0.005 per cent, is one of the most difficult of analytical problems. The classical method, consisting of volatilisation of boron with methyl alcohol and titration of the distillate with standard sodium hydroxide, is quite unsuitable for the trace amounts added to steel.

Choice of methods is restricted to a very limited range of rather unsatisfactory colour reagents, such as quinalizarin (1:2:5:8-tetrahydroxy-anthraquinone) and curcumin or turmeric.

Quinalizarin is of unstandardised quality, and results can only be related to calibrations prepared for each bottle of the reagent. The reagent must be prepared in strong sulphuric acid, 90/98 per cent concentration, and variations of performance appear to be

critically related to minor variations of sulphuric acid concentration.

A pronounced purple colour is exhibited by the reagent solution itself, and the blue boron complex must be measured by comparing gradations of colour from the pale-purple of the reagent itself to clear-blue, which occurs at about 0.1 mg. of boron per 100 ml. This is equivalent to 0.01 per cent boron on a 1 g. steel basis, and therefore all amounts below this value must be measured by matching modifications of the purple reagent base colour.

Critical Control Necessary

Curcumin, the alternative reagent, develops a red colour with boron on evaporation to dryness of hydrochloric acid solutions after treatment with oxalic acid. The red colour is then extracted with alcohol and the colour compared against a prepared standard series. Very critical control of reagent excess is necessary, as the red boron complex is modified by the orange yellow colour of the reagent itself.

There are also difficulties of application with both these reagents such as loss of volatile boron compounds during solution, the difficulty of concentrating or evaporating solutions other than in alkaline medium, pick-up of boron from glassware, and so on.

Procedure based on that of Rudolf and Flickinger is the simplest, and consists of solution of the steel with sulphuric acid under reflux, after which the ferrous sulphate is salted out in 95 per cent sulphuric acid, and quinalizarin added to the concentrated extract. Alloy steels giving coloured salt solutions, for example, chromium steel, require a separation procedure, mercury cathode electrolysis affording a good separation from boron; separation of iron, chromium, etc., from boron is also made with sodium hydroxide, and this is the separation which normally precedes the application of the curcumin reagent.

The usual gravimetric methods, based on hydrolytic precipitation as tungstic acid and ignition to the oxide are of doubtful accuracy for the determination of small amounts of tungsten in steel. Below about 0.2 per cent recovery is usually extremely poor and amounts of the order of 0.1 per cent or less may escape notice entirely.

Various expedients have been tried in order to improve the yield, but without marked success, and it is noteworthy that most of these devices lead to increased co-precipitation of molybdenum. In the absence of molybdenum it is easier to adjust the conditions to provide a quantitative or near quantitative yield of tungsten.

Molybdenum contamination is influenced by a variety of factors, such as the concentration of the two elements in solution, the ratio of their respective concentrations, the acidity of the solution and the use of organic precipitating or flocculating agents.

Conditions which favour a quantitative yield of tungstic acid also favour increased molybdenum contamination. Thus, minimum acidity, sulphurous acid hydrolysis from a ferrous solution, cinchonine, rhodamine B, and so on, all improve the tungsten yield, but the residue is liable to contamination from molybdenum, particularly when large amounts of both elements are present.

On high tungsten/molybdenum steels the contamination is so serious that in applying the B.S. rhodamine B procedure to high speed steels (7 per cent W, 4 per cent Mo) 12-25 mg. of MoO_3 have been found in the WO_3 residues.

The ideal reagent for tungsten must, therefore, be not only more efficient than existing ones as a tungsten precipitant, but it must also be more selective. It must as well be capable of application under conditions which permit control of molybdenum coprecipitation, it must, for example, operate at a relatively high acidity 1-2N with respect to hydrochloric acid and be effective in an oxidised iron solution.

In the meantime, the existing procedures are reasonably satisfactory for medium and high tungsten content ranges, and in the absence of much molybdenum.

Apart from this, there is the dithiol absorptiometric procedure, which meets the most stringent accuracy requirements down to the lowest content levels, but is rather complicated in operation for regular use as a routine procedure on batch control.

Tungsten Determination

Tungsten may be determined in the presence of columbium by the dithiol procedure, the columbium being separated by treatment with phosphoric and sulphuric acids.

Methods based on the tungsten-thiocyanate colour have also been used extensively in recent years. It is certain that this reaction is critically affected by variation of conditions and the most exact and rigid standardisation is necessary. The

most recent version of this method to be tested by the physico-chemical analysis subcommittee of BISRA has shown real promise; in this procedure the reaction is carried out in hydrochloric acid (1:1), and titanous chloride is used to reduce the thiocyanate complex. There is interference if much molybdenum, copper or vanadium are present.

Polarographic methods have not yet been developed for the determination of tungsten in steels. So far, only lead and copper have been determined in this way.

Molybdenum is still determined by the old caustic soda/lead molybdate process and by the α-benzoin oxime precipitation method. The application of both these methods is becoming restricted by the interference of residual tungsten.

Residue treatment to remove co-precipitated tungsten is extremely difficult and it is therefore not surprising that steel chemists are turning to the thiocyanate absorptiometric process.

This method is dependent on a somewhat critical balance of reagent concentrations, and at very low molybdenum concentrations the bleaching of the corresponding ferric thiocyanate colour is erratic and incomplete. There is always a small residual ferric iron colour in the lowest ranges, and this accounts for the irregularity of the curve near the point of origin.

Determinations in the lower range are subject to iron blank values of comparable magnitude to the amount of molybdenum present, with the result that determinations in the region of 0.02 per cent or less are of low accuracy, and may be as much as 100 per cent in error. This residual iron blank can be reduced by increasing the stannous chloride concentration.

Insolubility Causes Interference

Interference from copper occurs, however, due to the insolubility of cuprous thiocyanate, and this becomes more marked with increasing stannous chloride concentration. The problem, therefore, is to find the best compromise between the reduction of iron blank and the incidence of copper interference.

Use of titanium salts is now being investigated by the Brown-Firth Laboratories. These salts appear to catalyse the spontaneous and complete bleaching of the ferric colour and permit the most favourable balance of stannous chloride and thiocyanate concentrations to be used.

Mercury cathode electrolysis is readily applied to steel solutions for a variety of purposes, but its full exploitation still lies in the future. Present work in the Brown-Firth Laboratories is being directed towards the development of an apparatus capable of removing as much as 10 g. of iron chromium, nickel, etc., in a matter of one to two hours. Several difficulties have been encountered, particularly with chromium-rich solutions, but a point has been reached where satisfactory conditions can be specified for steels soluble in sulphuric acid solution.

Some Further Problems

Further problems include the treatment of carbide residues from alloy steels and the application of solvents other than sulphuric acid; particular difficulties arise in oxodised ferric solutions. If these problems can be solved, a field of great scope will be opened up, particularly in the determination of residual and trace amount of elements such as aluminium, titanium, zirconium, vanadium, calcium, etc.

As regards the determination of aluminium in steel, the aluminium may be determined by precipitation as the phosphate after mercury cathode electrolysis. The procedures of Gentry and Sherrington (1946, 1950) using a 1 g. sample have, however, given satisfactory results. Here aluminium oxinate is formed, extracted with chloroform, and the absorption of the extracted solution measured. The aurine tricarboxylic acid procedure is unsatisfactory.

In miscellaneous determinations it must be emphasised that considerable segregation of lead often occurs in steels. Hence, lead should always be estimated on at least 10 g. samples, though some workers continue to use 1 g. samples. The folly of this latter procedure may best be illustrated by a recent case where a bar of steel of about 1 in. cross section and 2 ft. in length gave on analysis no lead reaction at one end and 0.25 per cent of lead at the other. Steels made by the Ledloy process, however, are less likely to suffer from segregation.

The most satisfactory method for the determination of oxygen in steels is that based on vacuum fusion. Methods based on aluminium reduction either in hydrogen or *in vacuo* are not very popular, as the blanks often give trouble.

For phosphorus the Vaughan procedure is unsatisfactory, due among other things to the fact that losses are incurred by spitting of the solution being evaporated. In batch analysis of phosphorus it is quicker to titrate the phosphomolybdate precipitate with caustic alkali than to measure the absorption of the molybdenum blue formed on subsequent reduction.

The phosphomolybdylvanadate method of Harrison (1933), who determined phosphorus in cast iron, is sensitive to interferences in solution and to temperature effects. Again, it is less sensitive than the molybdenum blue procedure.

The Institute of Physics

X-ray Analysis Group Spring Conference

THE Texture and Structure of Metals will be the subject of the Spring Conference of the X-ray Analysis Group of the Institute of Physics to be held at Ashorne Hill, Leamington Spa, on Thursday and Friday, 12 and 13 April. A small exhibition is also being arranged in connection with the conference.

THURSDAY 12 April

2.00-4.30 p.m. Textural Studies.

(i) 'Lattice Strains in Deformed Metal Aggregates.' Dr. G. B. Greenough (Royal Aircraft Establishment, Farnborough).

(ii) 'A Simple Method of X-ray Microscopy.' Dr. R. W. K. Honeycombe (Cavendish Laboratory, Cambridge).

(iii) 'Microbeam Experiments on Cold-Worked Copper and Other Metals.' Mr. P. Gay (Cavendish Laboratory, Cambridge).

(iv) 'The Structure of an Alpha/Beta Brass.' Mr. R. J. Davis (Inorganic Chemistry Laboratory, Oxford).

(v) 'The Development of Preferred Orientation in Metals on Deformation.' Mr. E. A. Calnan and Dr. C. J. B. Clews (National Physical Laboratory, Teddington).

5.30-6.30 p.m.—Techniques of X-ray Analysis. A number of short contributions.

8.30 p.m. Evening Lecture.

'The Behaviour of Electrons in Alloys.' by Professor N. F. Mott, F.R.S. (H. O. Wills, professor of physics, University of Bristol).

FRIDAY 13 April.

9.00-9.30 a.m.—Annual General Meeting of the Group.

9.45 a.m. - 2.30 p.m. — Structural Studies (Phases).

(i) 'The Importance of Crystal Structure Determination in the Study of Alloys.' Professor G. V. Raynor (University of Birmingham).

(ii) 'The Gamma Brass Phases in Copper and Silver Alloys.' Dr. W. Hume-Rothery, F.R.S. (Inorganic Chemistry Laboratory, Oxford).

(iii) 'The Structure of Mn_3SiAl_9 and its Relationship to Other Intermetallic Compounds.' Dr. K. Robinson (Cavendish Laboratory, Cambridge).

(iv) 'The Structure of Sigma-Phase Alloys.' Dr. Audrey M. B. Douglas (Cavendish Laboratory, Cambridge).

(v) 'The X-ray Examination of Uranium at Various Temperatures.' Dr. J. Thewlis (Atomic Energy Research Establishment, Harwell).

(vi) 'The Constitution of Some Alloy and Carbide Systems Relating to Heat-Resisting Materials.' Mr. H. J. Goldschmidt (B.S.A. Group Research Centre, Sheffield).

2.00-4.30 p.m.—Structural Studies (Transformations).

(i) 'Kinetics of Order-Disorder Transformations.' Dr. H. Lipson (College of Technology, Manchester).

(ii) 'Diffuse Diffraction Effects Accompanying the Ordering of CoPt.' Dr. J. B. Newkirk (Carnegie Institute of Technology, U.S.A., and Cavendish Laboratory, Cambridge).

(iii) 'A Theory of the Transformation in Cobalt.' Dr. J. W. Christian (Inorganic Chemistry Laboratory, Oxford).

(iv) 'An X-ray Method of Preparing Isothermal Transformation Diagrams.' Mr. H. T. Heal (Physics Laboratories, British Iron and Steel Research Association).

(v) 'Structural Transformations during the Tempering of Carbon and Nitrogen Martensities.' Dr. K. H. Jack (Cavendish Laboratory, Cambridge), (now at, Chemistry Department, King's College, Newcastle-on-Tyne).

(vi) 'An Analysis of the X-ray Diffraction Line Shapes from Martensite.' Dr. R. A. Smith (University of Birmingham) (now at, Development and Research Department, Mond Nickel Company, Birmingham).

(vii) 'Some Effects of Cold-Work on Cementite in Steel.' Mr. D. V. Wilson (University of Sheffield).

Dyestuffs Repay Science

Conclusion :—Diagnostic Aids, Food and Cosmetics

IT is a truism that the cause of a malaise should be known before its treatment can satisfactorily be undertaken. Early diagnosis can often prevent the development of serious trouble by allowing the proper curative treatment to be given in good time. It is at least equally as important to be able to diagnose a complaint as to know how to treat it when its presence is established. Although the contributions that the dyestuff makers have made to medical science are not inconsiderable in respect of the treatment of disease, yet those that they have made to the diagnosis of disease are greater and more widely applied. The bacteriological tests which constitute the backbone of effective diagnosis would often be impossible without the use of the staining solutions that are employed. Other uses of dyestuffs as diagnostic aids are noted below.

Fluorescent Dyestuffs

Fluorescein itself has been used for diagnosing damage to the eye; it does not stain the normal conjunctiva but it makes a well-marked stain where the epithelium has been damaged and by so indicating the location of the damage enables accurate diagnosis to be made.

Lange and Boyd[38] have described the clinical application of fluorescent dyestuffs to the diagnosis of circulatory disorders. The fluorescent dyestuff is injected into the patient and then the relevant parts of the patient's body are irradiated with ultra-violet light. The presence of the fluorescent dyestuff is indicated by a visible fluorescence and the time taken for this to appear after injection of the dyestuff may give valuable information as to how the blood is circulating. In the case of gangrene, those parts which are not functioning properly can be sharply differentiated by this means from those which are receiving an adequate supply of blood, and it is thus possible to know exactly how severe an amputation must be.

Other Diagnostic Uses

Many other reports have been made as to the use of dyestuffs in diagnosis. Some, particularly those dealing with tuberculosis and cancer, will doubtless be received with caution. The following indicate the lines along which work is proceeding.

Methylene Blue solutions have been suggested by Salinas[37] as an aid to the diagnosis of gastric cancer. Indigo-carmine has been employed by Okada[39] in the diagnosis of genito-urinary tuberculosis. Hollander *et al*[39] have described a new method which involves the use of Phenol Red for studying the subjects' gastric contents.

MICROSCOPY

The dependence of many of the sciences on the microscopist is not always fully realised. It has been suggested with some cogency that if we had lacked the microscope our knowledge of botany, zoology and biology would have been to-day more or less what it actually was a hundred years ago. Certain it must be that but for the microscope, bacteriology would have been only ill (if at all) developed; the treatment of diseases due, as so many are, to bacteria would probably have been very poorly developed. Where, too, would fibre science have been without the microscope? Dyestuffs do not make microscopy possible; microscopes were used long before there were any synthetic dyestuffs, but dyestuffs have made microscopy a more efficient adjunct to the sciences. Dyestuffs, used to stain the specimen, enable detail that would otherwise be missed to be seen and photographed. Staining of microscope specimens is an art. At its best it is a specialist's job; sometimes a single specimen will be stained with three different dyes, each one of which will stain a separate feature of the specimen.

Some idea of the extensive use made of biological stain indicators is to be found in a BIOS report[40] which lists 51 bacteriologist's stains and twelve biological indicators that were formerly made by I. G. Farbenindustrie A.G. The dyemakers certainly looked after the interests of the microscopist and by so doing served many other sciences.

According to Johnson[41] the stains most generally in use are haematoxylin, carmine, picro-carmine, and a large number of aniline dyes. Of these, the best for staining bacteriological preparations are Crystal Violet, Methyl Violet, Gentian Violet, Methylene Blue, Thionin, Toluidine Blue, Basic Fuchsin, Safranin, Bismarck Brown and Chrysoidin. They are best kept as saturated solutions in alcohol and diluted before use. Johnson[41] points out that most bacteria will

stain easily but that tubercle, leprosy and smegma bacilli are difficult; these are best stained with a mixture of Basic Fuchsin and phenol in alcohol/water. Filters, too, are of great importance to the microscopist, even more useful to him than to the photographer; nearly always the microscopist is anxious to increase contrast. A range of filters using many dyestuffs is available together with information relating to their absorption bands; typical dyestuffs that are used for this purpose include Aniline Blue, Bismarck Brown, Congo Red, Erythrosine, Methyl Violet, Orange II, and Safranin O. Acridine Yellow is commonly used in fluorescence microscopy, according to Hughes[43], for the routine examination of tubercular sputum.

Bacteriology has gained much from the application of dyestuffs to microscopy, and countless of its applications have advanced the medical and biological sciences. Two rather different applications are as follows:

It has been shown by Rogers[44] that pipes and cables which are normally corroded by the action of bacteria in water and soil can be protected by Acridine Yellow which kills the bacteria and so prevents the reduction which the live bacteria bring about of sulphate to hydrogen sulphide, which is the corrosive agent.

Mechaels[45] has reported that if the dyestuffs which have been used to dye our clothing contain phenolic hydroxyl groups in their molecules, they will protect the fibres from bacterial decomposition.

Genetics

Far and away the most important service that has been rendered by the dyestuffs chemist to the geneticist is that of the provision of suitable stains to enable the chromosomes and their workings to be observed microscopically. Perhaps, too, of considerable importance is the study of genetics in flowers that has been made, and which has been controlled largely by the natural colouring matters in the flowers.

Flower colouring matters are mostly anthocyanines; their chemistry has been worked out by Robinson and his school, and a full knowledge of the inter-relationships between the several members, *e.g.*, pelargonidin, cyanidin, peonidin, delphinidin, malvidin, and hirsutidin, has been of help in studying the genetics of flowers. It is interesting to compare the natural with the synthetic product, to note that the anthosyanins—the flower colouring matters—will dye tin-mordanted silk or tannin-mordanted cotton in shades of red, blue and violet. These are fast to light but not to soap, so that they have no technical importance for dyeing fabrics.

Perhaps, too, some synthetic dyestuffs may be able to induce mutations. Acriflavine induces in yeast a small-colony mutation which lacks normal cytochrome respiration and which may perhaps throw some light on this subject.

Insecticidal Uses

The stability of insecticides towards the action of light can sometimes be improved by the addition of a dyestuff, particularly by one which absorbs high frequency radiation. Thus, M. de Domenico and G. B. R. de Domenico[46] showed that derris and pyrethrum can be protected against the action of light by treatment with Chloramine Yellow G. The application of the dyestuff to the insecticide may be made by means of a film-forming solution such as gelatine.

Effect of Some Azo Dyes on Cockroaches

Nolan and Baumann[47] found that 0.2 per cent of *p*-dimethylaminoazo-benzene fed to cockroaches *Blattella germanica* caused characteristic lesions at the near end of the Malpighian tubules, although it had little effect on their rate of growth, survival, or reproduction. Two other azo dyes acted similarly. It is worthy of note that azo dyestuffs never occur naturally; many of the groupings typical of man-made colours have been found in Nature's pigments, but never the azo grouping—that is peculiar to the synthetics.

The fungicidal properties of some dyestuffs have already been discussed insofar as their medical applications are concerned; an application of a different sort is the following:—

Marcard[48], showed that certain dyestuffs could be used to fight mildew on the vine. Brilliant Acridine, Orange E and Brilliant Phosphine S, which last is the zinc compound of the first-named dye, had an appreciable action in 0.05 per cent solutions, even in such great dilution they were at least as effective as Bordeaux mixture.

Analysis

Chemical analysis has advanced fast in the last twenty years and one of the most outstanding of its many new developments has been the application of organic materials

of the dyestuff type to the detection and estimation of metals. Thus *p*-dimethylaminobenzylidene rhodanine gives a reddish-violet spot with silver, quinalizarin gives a blue colour with beryllium, Titan Yellow gives a red colour with magnesium, Rhodamine B in the presence of nitrous acid gives a violet colour or precipitate with antimony, and Alizarin in the presence of dilute hydrochloric acid gives a reddish-violet colour or precipitate with zirconium.

Alizarin Test for Ammonium Ion

A simple chemical test which will interest students and teachers has been suggested by Hubert Frings[49], the distinguished entomologist. It is that alizarin paper should be used as an indicator for the detection of the ammonia that is evolved when a strong base, usually caustic soda, is added to an ammonium salt. Alizarin paper turns purple when moistened and exposed to ammonia vapour; on drying the adsorbed ammonia evaporates and the paper returns to its original yellow colour. This behaviour shows that the purple colour was not due to sprayed caustic soda, because if it had been the second change from purple back to yellow would not have taken place. The test is obviously an improvement over the usual use of litmus paper which is turned blue either by ammonia vapour or by sprayed alkali and which offers no way of distinguishing between them.

According to Noll[50] ligninsulphonic acid is commonly used as an adulterant in soap and its presence can easily be detected with various acridine dyestuffs.

According to Boxer and Jelinek[51] streptomycin is often determined by measuring the amount of fluorescent hydrazone which is produced when it reacts with acridyl-5-hydrazine. Fluorescent acridines are also used as indicators, when dilute or murky solutions have to be titrated, the operation being carried out under an ultra-violet lamp.

Dyestuffs have provided many of the indicators of analytical chemistry, although it is inevitably true that a dyestuff which has useful fastness can never be an indicator. Congo Red turns blue in acid and has been commonly used in laboratory work; turmeric gives a red colour which is a sensitive test for traces of boron. Often, however, coloured or turbid solutions have to be titrated; then, as just indicated, fluorescent indicators may be useful, or alternatively the relatively new adsorption indicators. A well-known individual member of this last class is dichlorofluorescein, useful for the titration of dilute chloride solutions.

The Mechanism of Syneresis

Syneresis is a phenomena that has been familiar for many years to the colloid chemist, but is one which has never been thoroughly understood. When a jelly is allowed to stand it gradually loses liquid which separates (i.e., it undergoes syneresis), leaving the jelly substantially unchanged in appearance. Clearly the phenomena should offer an approach to a knowledge of the structure of jellies. A good deal of work has been carried out on the subject and various dyestuffs have been used to help to elucidate the mechanism of syneresis. Rossi and Nicolini[52] found that the syneresis liquid from agar-agar gels containing dyestuff, had always a lower content of dye than the gel. The inference to be drawn from this is that the jelly structure is one which readily permits adsorption or is one which has a very large internal surface.

Photography

Vogel[53] in 1873 fortuitously discovered that photographic plates stained with a yellow dye had their greatest sensitivity to green instead of to blue light. Later Magenta, Methyl Violet, and cyanine were found to have a similar sensitising action towards light of the lower frequencies. In 1875 Waterhouse found Eosin was a powerful sensitiser for green and yellow light, and the very similar Erythrosine is still used for this purpose.

Plate Sensitisers

To-day cyanines have largely been replaced for photographic use by isocyanines; these are reddish-purple dyes but too costly and fugitive to be of value for fabric dyeing; they sensitise photographic plates up to the orange. The carbocyanines are a still later development, they were produced by the action of formaldehyde on the isocyanines; they are sparingly soluble blue substances which sensitise photographic plates in the yellow to red parts of the spectrum and are more active than the isocyanines. Typical examples are: Isocyanine. Sensitol Green (1.1′,6-trimethylisocyanine iodide); Carbocyanine. Sensitol Red (1.1′-diethyl-2.2′-carbocyanine iodide) Kryptocyanine is a very powerful sensitiser for the red and infra-red, and so is Neocyanine.

Such cyanine dyestuff sensitisers are indispensable in aerial photography as well as in

astronomy. They have also contributed to the development of panchromatic plates, which enable a true tone rendering to be made in monochrome, and to increased speeds of plates and films, and to colour photography. One of the most famous of these cyanines was the blue dyestuff pinacyanol, whose use was patented[54] in 1905. Another was neocyanine which, according to Babcock[55], enabled the solar spectrum to be photographed as far into the infra-red as 10,750 Å (1.07μ), by the use of photographic plates which had been sensitised with it. This was the greatest penetration into the infra-red that had been made.

The application of the cyanine dyes to photography has recently been reviewed by Hamer[56]. He points out that the ranges of sensitivity of various photographic emulsions are as follows:—

	Ångstrom units
A. Gelatino silver chloride emulsion as used for printing paper	3500-4500
B. Gelatino silver bromide emulsion as used on films and plates	3500-5300
C. As B but bathed in a solution of isocyanine	3500-6300
D. As B but bathed in a solution of isocyanine	3500-6300
E. As B but bathed in a solution of pinacyanol	3600-7100

Cyanine as used in (C) is useless because it fogs the plate, but isocyanine (D) and pinacyanol (E) are free from this defect. It will be seen that isocyanine extends the sensitivity well into the green and pinacyanol extends it right into the red part of the spectrum. It has been observed by Leermakers[57] that the frequency of sensitising corresponds to the absorption maximum of dyed silver bromide. Apparently the silver bromide can only undergo the incipient reduction that is the preliminary to image formation if it absorbs some of the light energy that falls on it. Apparently, too, when light falls on ordinary silver bromide the yellow and red components are not absorbed; it is not difficult to understand that if the silver bromide is intimately mixed (dyed) with a substance such as a cyanine dye which absorbs light within this range, it is very much easier for the silver bromide to absorb and be activated by this light. The action is clearly very different from that of a light filter because the cyanine sensitisers are in contact with the silver bromide, probably dissolved in it as a solid solution.

By means of sensitising dyes used in conjunction with suitable light filters, plates can be made which have the same colour response as the human eye. Furthermore, plates sensitive into the near infra-red can also be made, *e.g.*, plates sensitised with heptamethincyanine are sensitive as far into the infra-red as 8,300 Å, and those sensitised with neocyanine to 10,750 Å. The optimum quantity of sensitiser varies from 5-100 parts per million of photographic emulsion; if too much is used, overall sensitivity of the plate is lost and additionally fogging may take place. Dye molecules may be absorbed in a monomolecular layer on the emulsion.

Desensitising Panchromatic Plates

Safranine is a basic dye of the azine class. It dyes wool and tannin-treated cotton red, and is used in calico printing. It has the property (just the opposite of the cyanines) of desensitising photographic emulsions and is of value for the development of panchromatic plates, which, after immersion in a solution of safranine, can be safely developed in a dim white light.

Food

The main purpose of this article has been to indicate the contributions that the dyestuffs industry has made to other branches of science and so to illustrate the gain in knowledge that it has made possible and the development of new techniques, the ability to do new things, which it has brought about. It is, however, often difficult to draw a clear line between scientific and humanitarian applications on the one hand and industrial uses on the other. For example, cherries, before use, are stored in a 'brine' which contains sulphur dioxide to preserve them and which reduces the natural colour of the fruit to a pale straw. Subsequently the cherries may be canned, used glacé for cakes, or maraschino for cocktails, and in each case they are dyed first. Apart from the increased sales that result, such truckling to aesthetic sensibility has plenty to commend it. This and similar applications were discussed in some detail by Hill[58] in 1937. Strawberry jam is improved in naturalness of colour by the addition of Edicol Ponceau RS; salmon and shrimp pastes have a pale biscuit colour that is usually improved;

fondants and toffees are made more attractive by colouring. Polony skins, lemonade powders, soft drinks, ice-cream, custard powder, blancmanges are all made more inviting with the aid of dyestuffs. Naturally, dyestuffs used in the food industry have to be selected with great care and are used in very small quantities, of the order of 50 parts per million. The food industry owes more than is commonly realised to the dyestuffs chemists; even the 'canned meat' dog foods have been improved by dyestuffs.

Dyes Used in the Food Industry

Dyestuffs commonly used for colouring foods are Tartrazine, Erythrosine, Indigo Carmine, and Guinea Green. Natural Carmine is obtained from cochineal; it needs 60,000 female insects to make 1 lb. of cochineal.

An investigation carried out by Kozlov[40] on the action of coal-tar dyes used in the food industry on the animal organism has shown that basic Fuchsin, Methyl Violet and acid Fuchsin are vaso-constrictors. Methyl Violet and basic Fuchsin also reduced the intestinal activity even in 0.1 per cent, but Amaranth and Indigo Carmine had no such effect.

Cosmetics

The cosmetics industry makes no bones about the dyestuffs it uses; fluorescent dyestuffs of the type of Erythrosine and Eosin are invaluable for lipsticks. Sun tan oils and lotions, hair creams and oils, face powders, eyelash liquids, and nail lacquers all endeavour to replace monotony by interest; all are the logical successors of woad. Nor are the dyestuffs that they contain necessarily very far removed chemically from that flavone, luteolin, which is present in wild woad.

Other uses of dyestuffs, which it would be out of place to do more than mention here, are to be found in connection with the following: inks, carbon papers, typewriter ribbons, buttons, mother of pearl, indelible pencils, flowers such as honesty and statice, petrol, seed-dressing, wood and anodised aluminium. There are many more but this short list will indicate the range of materials which the dyestuffs synthesist helps to produce.

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The Universities and Industry

RELATIONSHIP between the universities and industry in the U.S.A. will be the subject of investigation by a team which will shortly visit America under the auspices of the Anglo-American Council on Productivity.

The team will include a vice-chancellor and three professors of universities in the United Kingdom, a secretary of a University Appointments Board, two principals of Technical Colleges, four representatives of industrial management, and one representative each of the Ministry of Education and the T.U.C. Education Department.

Dr. Dunsheath, director of Henley's Telegraph Works and chairman of Convocation of the University of London, will be leader of the team, and the secretary will be Mr. Fleet, assistant secretary of the Association of Universities of the British Commonwealth.

Subjects for study will include the education of graduates and their employment in industry, the interchange of staff between universities and industry and the provision of research facilities. The inquiry will embrace not only scientists, engineers and other technologists, but men and women from all faculties at both graduate and post-graduate level.

Dollar costs of the visit are borne by ECA whose New York office is preparing the itinerary in consultation with representatives of the universities and of industry in the U.S.A. The tour will include visits to a number of American universities, industrial plants, and conferences with educational and industrial organisations.

American Chemical Notebook

'AMILAR' has been adopted by E. I. du Pont de Nemours and Co. as the trade name for its synthetic polyester textile fibre, known since 1946 under the laboratory designation of Fibre V. The synthetic fibre known in England as Terylene is being produced by Imperial Chemical Industries, Ltd. (THE CHEMICAL AGE, *63*, 705). Continuous filament yarn and staple are being made in an experimental operation at the Seaford, Delaware plant of Du Pont's Nylon Division. A new plant is to be built at Kinston, North Carolina, for commercial production.

* *

INCENTIVES to encourage domestic uranium exploration and mining have been issued by the U.S. Atomic Energy Commission. Bonus pay of up to $35,000 is now offered for fresh finds. The new price and bonus schedule applying only to U.S. miners provides a top payment of $7 per lb. for uranium oxide compared with a previous maximum of $2. The new incentives are in addition to the $10,000 bonus offered since 1948 but never yet collected, for the discovery of a new deposit of high-grade uranium ore. To obtain the bonus payment, a prospector must find ore assaying at least 20 per cent uranium oxide, and deliver at least 20 short tons. No such claim has yet been made.

* *

THE desirability of promptly establishing a synthetic liquid fuel industry under private enterprise was emphasised by Oscar L. Chapman, secretary of the Interior, when he submitted to Congress the report on research in synthetic liquid fuels by the U.S. Bureau of Mines during 1950.

Such an industry, set up with Government assistance under existing legislation, would open up new sources of supply for petrol, diesel oil, chemicals and other essential products from coal and oil shale.

Full support would be given to competent organisations or groups of organisations offering sound proposals for undertaking commercial oil shale operations. The Department of the Interior, said Mr. Chapman, would also encourage construction of one or two plants for the production of synthetic liquid fuels by the direct hydrogenation of coal. This would be the first step in allowing coal, the largest fuel reserve in the U.S.A., to begin carrying some of the heavy demands for liquid fuels.

As to the other coal-to-oil process, gas synthesis, now being studied by the Bureau of Mines, Mr. Chapman said that further pilot plant and demonstration plant testing were necessary to establish cost estimates.

Research undertaken, both privately and by the Bureau, since 1944 showed that the setting up of the initial commercial-size synthetic fuel plants would involve little financial risk to either the Federal Government or industry.

Technological advances during the past year had all served to emphasise that the prompt development of a synthetic fuel industry based on oil shale and coal was in the best national interests.

* *

SYNTHESIS of progesterone, testosterone and other steroid hormones from leaves of the common tomato plant has been announced in Washington, D.C., by Dr. Leonard A. Scheefe, surgeon general of the U.S. Public Health Service. The discovery was made by Drs. Yoshio Sato and Erich Mosettig of the National Institute of Health and Dr. Alfred Katz, a visiting fellow from Switzerland. The steroid hormones are used for various menstrual disorders. Progesterone is also used for relief of cervical cancer and testosterone for the relief of breast cancer.

* *

RESEARCH on the utilisation of bagasse at the laboratories of the U.S. Department of Agriculture's Bureau of Agricultural and Industrial Chemistry, Peoria, Illinois, may open up new industrial outlets for the by-products of the sugar cane industry. It is proposed that pith and fibre from the fresh bagasse should be separated at the sugar mills. The fibre would be dried and sold to paper mills for making pulp to blend with wood pulps, while the blackstrap molasses should be absorbed on the dried pith and the mixture sold as an ingredient for livestock feed. To commercialise this research a pilot plant would be required capable of producing about 100 tons of pith and 200 tons of fibre for test purposes, while feeding experiments would be necessary to determine the actual nutritive value of pith and mixtures of pith and molasses.

Canvas Fire Hose Deterioration

Rot-Proofing Treatment

INVESTIGATIONS into the factors responsible for the deterioration of fire hose are summarised in a report prepared by the Joint Fire Research Organisation.* During the war fire hose was purchased centrally on a much greater scale than in peacetime, and under the conditions of supply of raw materials, manufacture and use, many difficulties were presented. The proportion of wastage was a matter of grave concern, and the Ministry of Home Security called for an examination of certain aspects of the problem by the Fire Research Division of its Research and Experiments Department. After the war some of the work of this Division was continued by the Joint Fire Research Organisation. At an early stage of the investigation it was found that, contrary to the assumption prevalent in the fire service that deterioration is chiefly due to abrasion, by far the most important factor was microbiological activity in the form of so-called 'mildew.'

The report points out that the term 'mildew' is commonly applied to any form of fungoid or bactericidal growth which gives rise to discoloration, often accompanied by rotting. Technically, attack may be divided into two types: mildew—limited to discoloration, accompanied by a musty smell—and decay, in which tendering and actual loss of strength occur in the material. Many types of micro-organisms confine their activities largely to discoloration and are themselves of little importance in hose deterioration. Growth of 'mildew' is governed by three principal factors, namely, temperature, moisture and nutriment.

Difficulties of Prevention

Efforts have been made in many quarters to develop a rot-proofing treatment, but, while some have been successful with certain types of fabric, fire hose presents special difficulties by virtue both of the close weave which is designed to restrict the passage of liquids through the fabric, and of the fact that it is frequently saturated with water. While it was possible to suggest methods which might be applicable to the yarn stage, the wartime requirement was a treatment that could be applied to the finished hose, preferably at Fire Service depôts or stations. There was also the question of the suitability of laboratory tests for determining the efficacy of any proposed treatment. After consideration of a number of known antiseptics likely to be applicable, it was decided to investigate a particular proprietary material, and arrangements were made for the co-operation of the proprietors.

Method of Treatment

The process consisted in impregnating the fabric of the hose with a solution containing an antiseptic in such a way that the antiseptic was distributed as evenly as possible throughout the hose and to a specified amount. It was found that the most satisfactory way of attaining this result was to immerse lengths of hose in the solution for a period of about 15 minutes, pass them through a light mangling process to remove the excess liquid, and allow them to dry. A determination of the amount of rot-proofer absorbed was then made by measuring the increase in weight. Subsequently a more detailed measurement of the antiseptic content and distribution was made by a colorimeter, and this was repeated during the course of the tests.

For the purpose of the laboratory tests a 75 ft. length of new, unlined flax hose, 2¾ in. diameter, was cut into 15 samples, each about 5-ft. long; these were divided into three batches of 5, one batch being left untreated for control tests and the other two batches being treated with the antiseptic solution. The solution was not identical in the two cases, since it was necessary to add a material for the purpose of 'fixing' the antiseptic in the fabric with a view to reducing the loss by leaching or evaporation, and it was intended to try two different materials for this purpose. The amount of antiseptic material was the same in both cases.

After treatment the samples were further divided into test specimens of various sizes and subjected to a series of processes. The middle portions of treated and untreated specimens were buried in a light garden soil and placed in a cupboard maintained at a

* Some Notes on Fire Hose (Fire R.O., F.P.E. Note No. 26/1950).

temperature of 30°C. and a moisture content in the soil of 20 per cent, which conditions favour microbiological growth. Samples were removed at intervals and cut into strips for tensile tests; some of the strips were tested in the air-dried condition and some were saturated in water.

Some specimens were subjected to wear under specific conditions in a machine in which a carborundum block is made to traverse the outside surface of the hose in order to simulate severe use.

A third series of tests consisted of leaching both with and without abrasion, followed by soil-burial. Specimens were submitted to a continuous water spray for a period of 24 hours.

The estimation of the amount of antiseptic retained in the hose after impregnation, mangling and drying gave a result of about 0.5 per cent of the dry weight of the hose. The proprietors stated that a content of 0.05 per cent was toxic to moulds under laboratory conditions but that, to allow for service conditions, it would be desirable to have a minimum content of 0.25 per cent. After a period of storage of three months under laboratory conditions, some specimens of both the treated batches which had undergone prolonged leaching and soil-burial showed an overall loss of antiseptic of between 72 per cent for treatment A and from 83 per cent to 94 per cent for treatment B. There were indications that both treatments caused some increase in the rate of percolation of water through the hose compared with the untreated specimens, but the variations and inconsistencies between individual sets of specimens were too great to permit of conclusive deductions.

Wear Reduces Mildew Resistance

What the tests did indicate was that the mildew resistance of the rot-proofed samples was reduced by the abrasion and leaching treatments carried out in the laboratory, but the reduction in strength was much less than that shown by the unproofed samples which had been subjected to similar conditions. Both treatments were effective in inhibiting mildew attack and would be beneficial for hose undergoing lengthly periods of storage under doubtful atmospheric conditions.

In order to compare the results obtained in the laboratory with what might be expected under service conditions, a field trial was carried out with the co-operation of the London Fire Force of the National Fire Service on full-length hose subject to the most severe treatment they were likely to meet in service. Qualitative agreement between the field trials and the laboratory tests suggested that the methods adopted in the laboratory would be adequate for the assessment of the efficacy of a rot-proofer.

Other factors studied by the investigators included the effects of storage conditions, rubber acid, paints, repeated wetting and drying, abrasion, percolation and resistance to fluid flow.

Further Advances Probable

Canadian Industry Increased Tenfold

FIFTY years ago the chemical and allied industries in Canada employed 4,107 persons in all, had an annual payroll of less than $2,000,000 and produced less than $13,000,000 worth of goods per annum.

To-day, recognised as one of the most important industrial groups on the Canadian scene, those same chemical and allied industries employ more than 40,000 Canadians, with a total payroll exceeding $95,000,000 annually, and an annual producton valued at approximately $600,000,000, or approximately £200,000,000.

Since 1925, the number of plants producing chemicals and allied products has increased from about 500 to more than 1,000; employees from about 14,000 to 44,000 in 1950 and the value of production to over $600,000,000.

In an address delivered under the auspices of the Chemical Institute of Canada, George W. Huggett, C.M.G., chairman and president of Canadian Industries, Ltd., said:—

'It could hardly have been foreseen at the time of Confederation that the very minerals and trees of this country would, within a generation or so, furnish us with rayon, fertilisers, plastics and many of the other things which now bring added comfort and convenience to our lives. After having studied the past contributions made by the chemical industry to our present standards of living, the possibility of still further advances cannot be doubted.

'But to the task of building the chemical industry there is no end. It is an industry characterised by frequent changes and rapid growth, and effective integration within its structure is essential if we are to gain the full benefit from the development of new materials and better methods of production.'

OCCA *Technical Exhibition*

Latest Developments in Paints and Oils

THE Oil and Colour Chemists' Association this week held a technical exhibition at the Borough Polytechnic, London, S.E.1, to demonstrate the many different aspects of the paint, plastics, and many other industries concerned with the vast field of oil and colour, their products and their derivatives, and thirty-four exhibitors took part in the exhibition.

The exhibits on show were divided roughly into four classes. Plastics were mostly concerned with showing the latest developments in property-bearing surface coatings. Heat-resistant, acid- and alkali-resistant, tough, finished products were all on the stands, each substance having been developed for specific purposes. Many exhibits dealt with pigments and paints, the salient points being investigation into the properties of zinc dust and zinc oxides in their application to paints, new applications of inorganic pigments, better and finer pigments, and developments in the investigation of the durability properties of various types of paint. There was also a fair amount of machinery on show, including numerous gadgets for the testing of various properties such as drying time, gloss, resistance to wear, as well as the more orthodox laboratory equipment such as mixers, ovens, desiccators, etc. Finally, the oil exhibitors put up a fine range of products from the cornucopia of modern oil and petroleum, extending from solvents to drying oils, from oilskins to plasticisers.

Plastics Section

In the plastics class, Cray Valley Products had on show a number of special property alkyd resins, for use when performance is more important than cost. Their new epichlorhydrin alkyds are exceptionally fast-drying with a high resistance to water, acids and alkalis. The silicone alkyds developed by them are principally a high-temperature-resistant resin, remaining unchanged in appearance and properties, even for long periods at high temperatures, as the writer found to his cost when he grasped an innocuous-looking disc that had been at 450°C. for five hours. 'Penta' or pentaerythritol alkyds, and alkyds derived from dehydrated castor oil were seen to be similarly rapid in drying and to have good durability and colour retention.

Plastonol's main contribution to the exhibition consisted of demonstrations of their new isomerised (cyclised) rubber—Plastoprene—a great deal of research on which has been going on over the past year. This is made from natural rubber, and a lump of it was on show. It resembled, to some extent, amber. However, its uses covered the coating of paper and the preparation of stable emulsions and styrenated types of great anti-corrosive strength. Styrene Co-polymers, Ltd., specialised in showing the properties of their products when applied as surface coatings. Exhibits demonstrated their 'Scopolux' range of alkyd resins with decorative brushing finishes, and others with industrial finishes (styrenated), and emulsionated flat wall paints. Emulsions were also demonstrated by the British Resin Products Company, in three different types—acrylate, alkyd, and Cashew polymer dispersions. They have extensively studied the technique of preparing these products, and their efforts appear to have been rewarded by good film properties and very small particle size.

Colour and Pigments

The colour exhibits on show at the Polytechnic were picturesque and varied. In the more orthodox range of stands, Associated Lead Manufacturers and Novadel, Ltd., put on show their latest developments in lead pigments and the raw materials from which they are made, the latter company also demonstrating laboratory apparatus for evaluating their products, including a powder feeder which feeds powdered materials at constant rates.

An interesting exhibit was that of the Paint Research Station. This stand set out to show the theoretical method of study of the properties of paint pigments. The lately developed radioactive tracer technique has not passed by the paint trade, and this valuable method is now being used for analytical work involving natural radioactivity, the activity of tracers and the detection of trace elements in paints. A specimen of pigment containing potassium was shown at the exhibition inside a detector cell. The rare radioactive isotope of potassium present could be

seen registering β-particle emissions on the man-high electronic counter next to the stand. Such processes as the rates of sedimentation in opaque solutions, flotation, and the location of drier elements can be studied by these methods, as well as the mechanisms of drier adsorption and the degradation and breakdown of films. Two techniques for studying the size of oil and varnish polymers in solution were also shown—the molecular weight method by evaporation from a solvent, and the light-scattering method by which an opaque solution can be made to register turbidity electrically, and hence particle size. A three-dimensional diagram was also on view to demonstrate how colours could be mathematically matched, with specimen matched colours attached (veracity guaranteed).

Zinc in Paints

Zinc dust coatings and the behaviour of zinc oxides under ultra-violet light was the subject of both the Amalgamated Oxides and the Durham Chemical's stands. Apparently the zinc oxides which fluoresce highly in ultra-violet light are those which exhibit the best non-chalking properties. This phenomenon has been put to use in testing the quality of zinc oxide pigments, springing as it does from the activity per unit surface area of the zinc oxide and its particle size, and so having an important bearing on the reactivity with paint media of the zinc oxide on mixing, as well as its film-breaking properties. An ultra-violet ray viewer demonstrated the different behaviour of various zinc pigments. Durham Chemicals also had on show some of the uses of metal stearates in the paint trade—sealing of paint surfaces, water-resistance, and so forth.

British Titan Products had titanium pigment dispersion as the subject of their exhibit, the mechanical and chemical aspects of the dispersion being illustrated by optical and electron microscope techniques. Other techniques were shown for finding the extent of dispersion and comparing the milling properties of various pigments. Fineness of grinding was also the emphasis on the exhibit of Golden Valley Colours, Ltd., whose pigments were of an average particle size of one micron—a remarkable size, produced by the micronizer—a valuable property.

Two other exhibitors had pigments on view. The British Industrial Solvents Company showed on their stand an assorted number of panels showing various faults occurring in the spraying of pigments on surfaces due to lack of secondary flow, and the means they had adopted to overcome them. 'Sandpaper' effect, caused by the paint drying too fast and being too thin, caused the gloss to be taken off the surface; 'moisture blush,' which they demonstrated as being caused by too many low-boiling-point water-miscible solvents being present, and the spraying carried out in the cold, could, they said, be cured by the addition of butyl acetate and spraying the paint at a higher temperature. Resin 'blush' was caused by the wrong admixture of solvents. Valuable work has been done by this company on remedying these faults.

Lastly, in the pigment section, the Blythe Colour Works had on show a variety of exhibits showing the more unusual and previously thought unsuitable applications of inorganic pigments.

Oil Products

The oil exhibitors showed many of their products. Shell and Petrochemicals had particularly fine stands, and the British Oil and Cake Mills Company had a graphic chart showing the origins, destinations, and final uses of linseed oil. This versatile substance can be made into everything from lino and soft soap to putty and hard tennis courts, and a piece of as many of these products as possible was on view at the stand. The company refine linseed oil (which comes unfortunately, from the Argentine), in several ways, depending on the end-uses. Acid refined oil is used for white lead, paste colours, and metal powder grinding, and alkali-refined oil for patent leather and leather cloths, printing inks, enamels and stand oil. Bottles illuminated from behind of the various types of oil made an attractive exhibit above the pieces of oilskin, lampshade parchment, putty, poultices, etc., that adorned the ground plan. Linseed, however, the company pointed out, is as difficult to come by as meat. The Argentines are hard bargainers, and buying is in the hands of the Government.

Shell Chemicals, Ltd., showed three branches of their activities to the public. Their wide range of solvents and the uses of these conversion products of the olefins and hydrocarbons that they obtain from cracked petroleum were on show, together with some

higher alcohols (alphanol 79, nonanol) containing from 7 to 9 carbon atoms which are made from olefin by-products obtained in 'Teepol' manufacture, and act as excellent plasticisers. Also they were demonstrating their work on epichlorhydrin diphenylolpropane resins which had exceptional adhesion to metal hardness, flexibility and chemical resistance. The properties of these resins were vividly demonstrated by four sheets of aluminium foil exposed to caustic alkali, strong acid, and water. Three of the sheets were coated with resin, and none of them was affected. The untreated foil was dissolved in 20 minutes by caustic alkali. These resins, say Shell, are finding important uses in the United States now.

A useful instrument for the accurate and rapid determination of the evaporation characteristics of solvents that has been developed by the American section of Shell was also on view here. It consists of a filter paper attached to the bottom end of a long, hair-thin helical spring, with a graduated scale behind it to allow for continuous reading as the solvent evaporates. The advantage of this ingenious instrument seems to be that whereas ordinary weight measurement will give the total time of evaporation, continuous measurement and the plotting of a graph will show the rate of evaporation over the portion of the curve that matters—the beginning and middle, and any change in rate. Several solvents are known, for instance, which decrease in evaporation rate towards the end of the evaporation time, even though they have actually been faster initially.

Oil Superior to Coal Tar

Petrochemicals, Ltd., had on show a number of aromatic raw materials they produce from petroleum. These products, they claim, are purer than the same obtained from coal tar, and far easier to obtain, due to greater ease of fractionation. Younghusband, Barnes & Co. exhibited their progress in the drying oil industry—especially with dehydrated castor oil, and had on show bottles of the various types of 'Conjugol'—an excellent drying oil for use in outside finishes and other situations. Some specially processed linseed oils were also on show as protective varnishes, printing inks, etc., with excellent film-forming properties.

The Geigy Company showed their sebacic acid alkyds, notable for film flexibility, and their powerful stable sequestering agents much used in the soap and shampoo trades —'sequestrol'—which coats and deactivates deleterious metallic ions in solution. Highly dispersed pigment dyestuffs were also to be seen on this stand.

Instruments Section

Among the many and varied instruments on show at the exhibition the following deserve mention: a triple rolling mill for reducing powders to microscopic size, together with a Test Sieve Vibrator for grading sizes of particle, and ball mills, produced by the Pascal Engineering Company; an ingenious pneumatic paint brush produced by the Bromak Pneumatic Paint Brush Company. Mechanical mixers of all sizes were on view at the Winkworth Machinery Company's stand, as well as the same sort of thing by L. A. Mitchell, Ltd., who exhibited rollers, fluid mixers and geared stirrers. Vickers, Ltd., showed a six-inch 'Uniroll' Paint Mill, and A.P.V. exhibited diagrams of their corrosion-resistant metal plant.

A large number of test instruments were demonstrated by Eben. E. Jelpke & Sheen Instruments, Ltd. Sanderson drying-time turntables, an automatic scratch test machine, bend test apparatus, film applicators and other machines were also on view, as well as a mechanical dipper.

Among the electrical instruments at the exhibition, Townson & Mercer showed among other exhibits a new thermostat bath with electronic relay; Evans Electroselenium showed a varied range of photo-electric instruments of which the main two on show were their reflectance spectrometer and glossmeter. For speed and accuracy of reading these instruments seem unrivalled. Finally, Techne (Cambridge), exhibited a new reflecting microscope of excellent performance.

To end this account, Baird & Tatlock's sintered glass filters covered an extremely wide range of design, and they also put on show other specialised equipment for oil and paint laboratories, such as viscometers, paint and scratch test and sediment apparatus, etc. Their potentiometric titration apparatus was very well designed.

Altogether the exhibition was attractively laid out and instructive to look at. As a medium for acquainting the trade with the manufacturers it seemed ideal. Photographs of some of the stands will appear in our next week's issue.

· PERSONAL ·

Three new Associates have been elected by the Textile Institute. They are: LEONARD GREGORY, textile research technician, Courtaulds, Ltd., Coventry; CLEMENT ROY NICHOLS, general manager, Alpha Spinning Mills, Australia; and EDWARD SZLOSBERG, textile chemist, research and development, Sandoz Chemical Works, Inc., New York.

MR. C. PACKER, who has been secretary of the Shirley Institute, Didsbury, Manchester, since its formation 31 years ago, is to retire at the end of March. He and his wife were entertained to lunch by the Council of the British Cotton Industry Research Association on 8 March.

DR. J. W. MCDAVID, C.B.E., chairman of the Nobel Division of Imperial Chemical Industries, Ltd., is retiring from the company's service on 30 September. He will be succeeded by DR. W. J. JENKINS, who has been deputy chairman of the Division since 8 March, 1951.

MR. N. G. MCCULLOCH, deputy chairman of the Calico Printers' Association, has left this country for a six weeks' visit to the United States where he and members of a 'universities and industry' team will study the education of graduates, their employment in industry and research facilities. The team is travelling under the auspices of the Anglo-American Council of Productivity. MR. CHARLES R. MORRIS, vice-chancellor of Leeds University, and PROFESSOR H. W. MELVILLE, professor of chemistry at Birmingham University, are also members of the team.

Obituary

BRITISH science suffered a severe loss last week by the death of PROFESSOR G. A. R. KON following his collapse in Manchester. Since 1942 he had been professor of chemistry at the Chester Beatty Research Institute of the Royal Cancer Hospital where his studies added greatly to the knowledge of the chemistry of cancer.

Elucidation of the tautomeric changes of organic compounds was an outstanding part of Professor Kon's work. Following the early recognition of ring-chain tautomerism his outstanding investigations was the unravelling of the reversible isomeric changes in unsaturated carbon chains, generally known as three-carbon tautomerism. He also greatly clarified the chemistry of the singularly intricate group of glutaconic acids.

The steroid and triterpene groups of natural products which have achieved considerable prominence in the last 20 years became the centre of Kon's work, and he used both the synthetic and analytic approaches. One of his main achievements was the synthesis of the key material ('Diel's hydrocarbon') which forms the basis of the sterol skeleton.

The death in South Africa of MR. HERBERT ALFRED HUMPHREY, a distinguished chemical engineer, at the age of 82, was reported this week. Born in 1868, he was trained at the Finsbury Technical College and the City and Guilds Institute, South Kensington. In 1900, with his appointment as engineer and departmental manager at the Winnington works of Brunner, Mond & Co., he began a connection with that company and its successors and subsidiaries which continued throughout his active life. One of his most notable achievements was the invention of the gas pump which bears his name.

In 1939 when Humphrey received the Melchett Medal for his paper delivered before the Institute of Fuel, he told of what was done in the 1914-18 war to speed up the purification of TNT when he was assistant director of the Department of Explosives Supply under Lord Moulton.

As chief engineer of the Munitions Inventions Department in 1917, with the shortage of ammonia, he was called upon to prepare specifications and estimates for a carbide-cyanamide factory.

Some two years later when Brunner, Mond decided to go on with the Billingham scheme for the synthetic production of ammonia by the Haber process, Humphrey was given the post of consulting engineer.

The Chemist's Bookshelf

THE ACRIDINES. By Adrien Albert. Edward Arnold & Co. London. 1951. Pp. 381. 70s.

With the ever-increasing volume and complexity of original work in the field of organic chemistry, the problem of indexing and identification has become very serious for the research worker. There have been several attempts, differing in method, to assist or relieve the worker from continual searches through the literature. The conventional method has been to maintain abstract journals with formula indices, and to collect and arrange the material in encyclopaedias such as Beilstein and Elsevier. this method requiring the constant issue of appendices. Dr. Dyson, when describing his new chemical nomenclature, envisaged the possibility of an all-embracing card index, capable of being mechanically sorted. Another method has been to collect information on specific classes or aspects of chemical compounds and publish them in review journals, or in the form of authoritative monographs. This book obviously falls into the latter class, and while its value to the specialist is obvious, the justification for its inclusion in the library of a department or firm, must be on the grounds of general utility and ease of access to information. The only valid criterion for such a judgment must be the completeness and reliability of the contents, and this book easily passes the test. The author, Adrien Albert, is well-known for his work in the fields of biochemistry and chemotherapy, and has, with his colleagues, been responsible for a proportion of the work described. The book is divided into three parts, the first section dealing with the preparation of acridines and their derivatives. This section is presented in a logical and orderly manner and includes representative preparations which the author or his colleagues have carried out, this being particularly welcome. The second section gives the physical and chemical properties of a number of substituted acridines, acridans and acridones. In the third section the author develops a number of theories upon the relation between chemical constitution and biological action in related series of acridine compounds. It is said that acridines are one of the few classes of compounds in which such a logical connection exists. The last section deals with other uses of acridine compounds, and includes discussion of the relation between colour and constitution in acridine dyestuffs, a very full review of the fluorescent and chemiluminescent properties of compounds such as 'luzigenin,' and an account of the use of acridines in analysis. An appendix containing practical hints upon manipulation is included, and the book has been very well indexed with a subject, author, and preparation index. Tables have been used throughout the book to condense and simplify the presentation of information.—J.R.M.

ANNUAIRE DES PRODUITS CHIMIQUES ET DE LA DROGUERIE. Annuaires Rousset. Paris, 1950. London: B.A.S. Overseas Publications. Pp. LXXIX + 1434 + 479. £3.

This remarkable publication, published in France, is as comprehensive from the point of view of buyers and enquirers in Great Britain as any directory in this country yet published. In fact, it is in many ways a great deal better, and for £3 represents the maximum useful information it is possible to get into one volume 3½ inches thick. And it is useful information. Ignoring the wealth of French, German, Spanish and Swiss information under the same headings, it contains in English a complete index of products and their manufacturers, a complete alphabetical index of manufacturers and what they manufacture, a complete geographical alphabetical list of manufacturers, and lastly a geographical list of exporters and importers, and what they deal in. A truly mammoth volume, this work should be the satisfaction of innumerable queries.—J.C.S.

HOME

Ardeer Factory Explosion

No direct evidence was available as to the cause of the explosion last April in the Ardeer explosives factory, Stevenston, of Imperial Chemical Industries, Ltd. Captain N. Fawcett, H.M. Inspector of Explosives, in the report stated that friction or percussion might have been caused by a box of explosive accidentally dropped. by grit being in the explosive, or by an excessive blow, direct or glancing, during stemming operations. No blame was attached either to the management or workers.

Tungsten Imports

Replying to a question about increasing the imports of tungsten, Mr. J. Freeman, Parliamentary Secretary to the Ministry of Supply, stated in a written answer that tungsten ore is at present mainly imported on private account, and importers are primarily responsible for securing adequate supplies. The Ministry of Supply made every effort for the highest possible quotas in trade agreements with producing countries and was itself negotiating long-term contracts for new or increased production from overseas mines. Production in this country would be restarted as soon as possible.

Boron Price Revisions

Borax and Chemicals Ltd., have announced that, as they are now faced with further increased costs of production. packaging, port-handling, delivery and. especially, ocean freight, they have found it necessary to increase prices, taking effect on 1 April, 1951, by £2 10s. on borax (decahydrate): £3 10s. on 'Pyrobor' (dehydrated borax), and £4 on boric acid, all grades, per ton.

The revised prices of main boron products as at 1 April, 1951, per ton, in bags, carriage paid customers' domicile, will be :-

		Borax £	Boric Acid £
"Pyrobor" (dehydrated)		57 10 0	—
Commercial	Granular	37 0 0	66 0 0
,,	Crystal	39 10 0	73 0 0
,,	Powder	40 10 0	70 10 0
,,	Powder (extra fine)	41 10 0	72 10 0
B.P. Grade	Granular	46 0 0	78 0 0
,,	Crystal	48 10 0	85 0 0
,,	Powder	49 10 0	82 10 0
,,	Powder (extra fine)	50 10 0	84 10 0

N.P.L. 'Open Day'

The National Physical Laboratory, Teddington, is holding its 'Open Days' for industrial representatives during 28-29 May from 10.30 a.m. to 5.30 p.m. These 'Open Days,' held this year in conjunction with the Festival of Britain, are an opportunity for scientific and technical workers in industry to see the research work and special investigations undertaken at the laboratory. Tickets are available for accredited representatives of industrial organisations, and can be obtained by writing to the director, not later than 8 May, indicating the day of choice.

Ramsay Memorial Fellowships

The Trustees will consider, in June, applications for Ramsay Memorial Fellowships for chemical research. One of the Fellowships will be limited to candidates educated in Glasgow, who can apply to be considered for either Fellowship. The value of each Fellowship will be £400 per annum, to which may be added a grant for expenses of research not exceeding £100 per annum. The Fellowships will normally be tenable for two years.

Full particulars can be obtained from the Joint Honorary Secretaries, Ramsay Memorial Fellowships Trust, University College London, Gower Street, W.C.1, to whom applications must be forwarded not later than 17 April 1951.

Electrodepositors in Torquay

The Electrodepositors' Technical Society holds its annual conference this year at Torquay, lasting from 11 to 14 April. As well as an elaborate social programme, the Society has arranged for 12 papers to be read before its members, dealing with such subjects as the rate of diffusion of hydrogen through steel during electrolytic pickling; studies in the discontinuities of deposited metallic coatings; American development of tin-zinc alloy plating; applications of interferometry, and others, including the zincate process for despositing on aluminium. In between times the Society hopes its members will make full use of the facilities of the town.

OVERSEAS

Metal Denser Than Lead

A new heavy metal with 50 per cent greater density than lead is now being commercially produced at its Detroit, Michigan, plant by the Carbaloy Co., Inc., Newark, New Jersey. Known as 'Hevimet,' the metal resists penetration of radioactive rays, and is also used for balancing of rotating parts. Another application is for the gamma ray screens used in radiotherapy.

'Dyox' Tasteless Water-Steriliser

The unpleasant taste of chlorine when used to sterilise water is being overcome in many cities in America, reports Dr. Aston, of the Mathieson Chemical Corporation, Cincinnati, by the use of chlorine dioxide, an unstable and explosive gas produced from sodium chlorate. Effective at as great a dilution as chlorine itself, it is generally as economical as other methods, says Dr. Aston, and has been shown to kill disease-causing organisms in water within five minutes in minute concentrations. In some cases where it is more expensive than chlorine itself, its use is justified by its lack of taste, its stability in water right up to the consumer's tap, and its superior biological activity. Moreover, it inactivates the poliomyelitis virus as well as free chlorine. It is at present widely employed for bleaching flour, for odour control in soap plants, and for the treatment of industrial wastes.

Atomic Energy and Industry

A widespread investigation into the possibility of utilising atomic energy for the production of electric power in industry has been begun by the Monsanto Chemical Company. Dr. Charles Allen Thomas, vice-president, believes that the investment in a combined power and plutonium plant could be amortised in a relatively short period of ten years. He is convinced that his proposed installation, which would use uranium for fuel, could produce plutonium more cheaply than it is being done at present by the Government. Many isolated areas with large phosphate deposits are short of power. One of the most likely use of atomic energy by Monsanto would be to supply power for chemical processes to refine raw materials.

Sawdust Instead of Topsoil

It is being suggested in America that the erosion of topsoil—a serious scourge over there—can be overcome by a short-term policy of treating the ground with a chemical humus made from the millions of tons of waste sawdust from the timber industry. Re-afforestation is still recognised as the best remedy, but waste wood in connection with timber operations in the U.S. is estimated at 60,000,000 tons a year, and initial tests on processing low grade cellulostic materials with acid catalysts and moderate heat have given very promising results. From ten to forty tons per acre were applied.

Wet Heat Damages Rubber

It has been found in America that rubber deteriorates twice as fast in moist heat as in dry heat, and that the surface cracking of rubber exposed to weather is catalysed by sunlight. Experiments in the hot dry climate of Abadan on the Persian Gulf, and in the damp atmosphere of Kuala Lampur in Malaya have led to the development of superior rubber compounds for use in the Tropics.

U.S. Welding Development

Welding of aluminium and other special metals ¼ in. thick and over has been made possible by a modern equipment called an Aircomatic welder used recently by the U.S. Navy in the construction of its first all-welded aluminium ship. The new welder is already being used by manufacturers of aluminium pressure vessels, chemical processing equipment, refrigeration and air conditioning equipment, by shipbuilders, and in railway car shops. It can be used to weld stainless steel, copper, brass, and certain bronzes as well as aluminium. The device, developed by the Air Reduction Company, New York, works in an almost continuous operation at much greater speeds than conventional methods. It uses electrical current of higher voltage and an automatic device that applies the binding metal. Ordinary methods used to weld pieces of metal of this size require the separate application of the binding metal, and take longer to build up a 'bead' of metal to the proper cohesive strength.

Next Week's Events

WEDNESDAY 28 MARCH

Food Group (S.C.I.)

London: Burlington House, Piccadilly, S.W.1, 6.15 p.m. 'Factors in Distribution Affecting the Quality and Nutritional Value of Foodstuffs.'

Manchester Literary and Philosophical Society

Manchester: Portico Library, Mosley Street, 5.45 p.m. Dr. J. W. Baker: 'Chemical Curricula in the Universities To-day.'

Chemical Engineering Group (S.C.I.)

Birmingham: The University, Edmund Street, 6.30 p.m. A. H. Loveless: 'Relation of the Chemical Engineer to the Chemist and Production Engineer in Industry.'

Royal Institute of Chemistry

Dublin: University College, Upper Merrion Street, 7.45 p.m. H. W. Moss: 'Thirty Years in the Dyestuffs Industry.'

British Iron and Steel Research Association

London: Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Dr. U. R. Evans: 'Fundamental Studies of Corrosion and their Importance to the Engineer.'

THURSDAY 29 MARCH

The Plastics Institute

London: Waldorf Hotel, Aldwych, W.C.2, 6.30 p.m. Paper: 'Recent Advances in Extrusion Machinery.'

FRIDAY 30 MARCH

The Pharmaceutical Society

Hull: Imperial Hotel, 8 p.m. D. E. Seymour: 'The Cortisone Problem.'

Royal Society Lectures

The Croonian Lecture for 1951 will be delivered on 7 June by Professor R. A. Peters, M.C., M.D., F.R.S., Whitley Professor of Biochemistry in the University of Oxford. The title will be 'Lethal Synthesis.'

The Bakerian Lecture 'Reactions in Monolayers' for 1951 will be delivered on 21 June by Professor E. K. Rideal, M.B.E., F.R.S., Professor of Chemistry in King's College.

Less Common Metals Research

As a result of the increasing interest in the technology of the less common metals and their possible industrial applications, the Battelle Institute, Columbus, Ohio, has established a new division under the directorship of Dr. Bruce W. Gonser, to guide development in the so far unexplored fields of metallurgy and the chemistry of metals. Dr. Gonser has made outstanding contribution to metallurgical science. From his work have come improvements in processes for making titanium and zirconium, pure thorium, vanadium, chromium, molybdenum, and other rare metals. At the Battelle Institute the dollar volume of research on the less common metals already exceeds $1,000,000 a year.

Coal Gasification in U.S.A.

A recent report by the U.S. Bureau of Mines describes the first laboratory processes for the continuous production of synthesis gas from pulverised coal in America. This gasification is not only the first step in the manufacture of synthetic liquid fuel from coal, but it serves as an easily-controlled method for testing the gas-making qualities of various types of fuel. A scale pilot plant constructed to feed pulverised coal through oxygen and steam processes at the rate of 45 lb. per hour produced a synthesis gas containing 90 per cent carbon monoxide and hydrogen and of low carbon dioxide content. Gas output rated as high as 600 cubic feet per cubic foot of generator volume.

Oil from Coal Plant

The modified Fischer-Tropsch process, known in America as 'hydrocol' and in Germany as 'Ruhr Lurgi,' will be used in the Union of South Africa's first oil-from-coal plant to be built at Colebrook, Northern Orange Free State. Colebrook has been chosen for the site of the first plant because it is halfway between the Rand and the new Orange Free State goldfields. The low-grade coal in the vicinity is good only for making petrol. The plant will use about 1,250,000 tons of coal annually and 5,000,000 gallons of water daily from the Vaal River. Production will be 35,000,000 gallons of petrol at first, and 100,000,000 gallons eventually. Legislation authorising the production is to be enacted in the present session of the South African parliament, and more plants of a similar nature may be erected later.

The World's Largest Single Oilfield

Important Developments at Seria

BENEATH the soil of Brunei, the smallest of the British Borneo territories, and extending outwards under the South China Sea, lies what is thought to be one of the largest single oilfields in the world. The Seria oilfield, as it is called, has become since the war the chief oil producer in the British Commonwealth, a position first attained in 1948 when the output of crude oil attained 2,850,000 tons. Since then the production rate has doubled, and it is now five times as great as it was during the best pre-war years. The geographical position of Brunei gives added importance to this oilfield, as it can supply a large part of the oil requirements of Australia, New Zealand, Malaya, and other countries.

Discovered in 1929 after years of exploration, the Seria oilfield is operated by a subsidiary of Shell, the British Malayan Petroleum Company. Commercial production began in 1942 after the completion of a pipeline from Seria to the refinery at Lutong in Sarawak. During the war the oil wells and installations were twice demolished, but reconstruction began almost immediately after the war in 1945. At first old and improvised equipment had to be used, but the position improved as time when on, and it is now so good that the company has put in hand a substantial development programme, which includes not only the raising of output but the building of a modern township for its staff and labour force, now consisting of almost 5,000.

Rapid Production Increase

The rapid increase in production (from a quarter of a million to 4½ million tons in four years) is due in large part to the convenient formation of the oilfield, which shelves deeper inland. Because of this it has been possible to carry out large-scale outstep drilling into the sea-bed, thereby substantially increasing exploitable reserves as well as actual output of crude oil. Across the border in Sarawak, the much less productive oilfield of Miri is believed to lie in the opposite direction to Miri, that is, to shelve seawards.

Seria's production, as well as that of the Miri oilfield, continues to be refined at Lutong which lies some 30 miles from Seria. The crude oil is refined into its two main parts—petrol and diesel oils—and by-products which include many types of wax for industrial purposes. Brunei's oil produces a satisfactory petrol, and a wide range of diesel fuels, with a minimum of refining processes. After refining, the oil is pumped, by means of submarine oil-loading lines or 'sealines,' into tankers which are prevented by shallow waters from coming close inshore. The construction of two such undersea pipelines, each three miles in length, was a features of the restoration work carried out by the Petroleum Company. A third line is due to come into operation this year.

Major Source of Employment

Brunei's oil output not only meets a large part of the essential needs of countries in the region but also, so far as the territory itself is concerned, constitutes the major source of employment and public revenue. About 80 per cent of the regular labour force in the State is employed by the Petroleum Company, while, in the last three years, oil royalties have contributed well over half of all public revenue. The increasing importance of oil in this respect is shown by the fact that this increased from £80,425 in 1946 to £1,009,238 in 1949. Oil royalties work out at 4s. a ton, the State taking one-tenth of all production and selling it back to the company at an agreed rate.

General Reserve Fund

Largely as a result of this revenue from oil, the State has been able in recent years to transfer large sums to its general reserve fund. This was taken into account when the Colombo Plan for Co-operative Economic Development in South and South-East Asia was being drafted. It was then estimated that Brunei, although in need of trained men as in the case of other countries taking part in the Plan, would be able to meet the cost of its development programme out of its own resources.

The Stock & Chemical Markets

BUDGET and international fears have combined to reduce business on the Stock Exchange where values in nearly all sections have lost ground. The set-back, however, has been moderate compared with the big gains made earlier in the year. In fact the recession now in evidence is attributed more to caution by buyers than to selling, which generally appears to have been moderate.

Although the Budget may very well dispel higher dividend hopes, many leading industrials shares are at levels which show not unattractive yields on the basis of last year's dividends. There is, of course, some doubt whether it will be possible to maintain dividends in future, but although shortages of materials, etc., must leave their mark on earnings of a wide range of companies, many should continue to do well, more particularly those which benefit from rearmament and the export trade drive.

A feature has been weakness of British Funds. This was also mainly because buyers are tending to hold off until after the Budget when the investment outlook should be easier to assess. Prevailing City view is that although the Budget will bring tax shocks, post-Budget markets are likely to show a revival, although the emphasis may be on shares of companies registered overseas and which are not, of course, affected by higher U.K. taxation.

At the time of writing, chemical and kindred shares are tending to attract buyers following their recent set-back when they reflected the general reaction in markets. The big increase in Monsanto's profits, the higher dividend, the 200 per cent share bonus and promise of a cash offer of new preference shares for shareholders helped sentiment. Monsonto 5s. shares have been prominent with an advance of 61s. 6d. Imperial Chemical firmed up to 44s. 4½d., F. W. Berk were 6s. 6d. 'ex rights' to the new shares. Brotherton 21s. 3d. and Laporte Chemicals 5s. units were active around 10s. 7½d., awaiting terms of the expected new issue. Fisons changed hands around 26s. 7½d., and the 4½ per cent preference around 18s. 6d. British Aluminium were 42s., and Borax Consolidated at 65s. remained under the influence of the share bonus.

Turner & Newall at 89s. 3d. have remained firm and yield less than 4 per cent on the basis of last year's dividend; but the market is assuming that higher dividend prospects are promising. There has been rather more activity around 46s. in Lever & Unilever, also on higher dividend talk. Associated Cement kept around 91s. 9d. and paint shares have been firmer generally, particularly Lewis Berger which were helped by the 100 per cent share bonus.

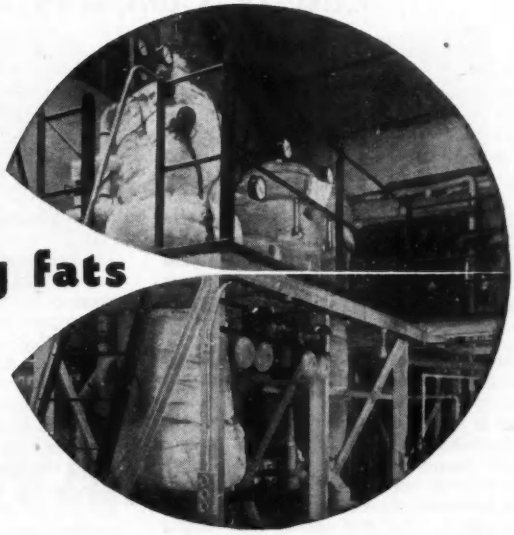
Yield of 6 per cent drew attention to Doulton & Co.'s shares around 48s. 9d. United Molasses turned firmer at 56s. and so far the 4s. units of the Distillers Co. have kept at 20s. The market is hopeful of a higher payment on the latter, but realises that this will probably depend in the main on Budget tax changes. In other directions, Staveley shares have been well maintained at 85s. 9d., and Guest Keen remained active around 54s. on hopes of a higher dividend or a special distribution of some kind from nationalisation compensation for the company's steel interests.

Resumption of dividends by Lacrinoid Products and by J. B. Broadley helped plastics shares. British Xylonite were firmer at 80s., Kleeman 11s. 3d. and British Industrial Plastics 2s. shares 6s. 6d. In other directions, Glaxo Laboratories were 59s. 6d. and Boots Drug 47s.xd. Oils were featured by buying of Shell, Canadian and Mexican Eagles, but on the other hand the Persian nationalisation moves put Anglo-Iranian down sharply to only slightly above £5—their lowest level since 1946.

Market Reports

LONDON.—Conditions on the industrial chemicals market show little change on the week and prices continue very firm. The demand both for home account and for shipment remains strong with increasing pressure for delivery of scarce materials. Consumers delivery specifications for the general run of the soda products and also for the potash chemicals are being met with fair regularity, and in most other sections and movement against contracts is well up to schedule. Among the non-ferrous metal compounds there has been a steady call for sulphate of copper at the recently advanced price, and both the white and red leads remain in good demand. The movement in the coal tar pro-

[continued on page 472



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Law & Company News

Albright and Wilson, Ltd.

Increased profits and ordinary distribution for 1950 were announced by Albright & Wilson, Ltd. Profits available to the parent company were £216,724 higher than in 1949 and the ordinary distribution was £16,945 more. A second interim dividend of 9 per cent is declared payable on 6 April on £2,028,284 ordinary capital which includes the £1,014,142 capitalised last December. A first interim of 10 per cent (same) was paid on £1,011,582. Final payment for 1949 was 15 per cent.

Lewis Berger and Sons, Ltd.

Consent has been given by the Capital Issues Committee for half the scrip bonus for which permission was sought by Lewis Berger & Sons, Ltd. Sanction was asked for the capitalisation of £1,054,550 for a two-for-one distribution. Permission has been given however only for one new 4s. ordinary share for every 4s. ordinary stock held on 27 March. The new shares rank immediately for dividend.

F. W. Berk and Co., Ltd.

At an extraordinary general meeting held on 12 March, 1951, authorisation was given for an increase of capital and capitalisation of reserves as a result of which existing ordinary shareholders receive one new ordinary share, credited as fully paid, for every share now held.

London Aluminium Co., Ltd.

Draft accounts of the London Aluminium Co., Ltd., for 1950 showed that it had been trading at a loss. The directors have instructed an independent firm of chartered accountants to investigate and report upon the trading and financial position of the company. Accounts for 1950 will be completed and circulated as soon as possible after the consultant's report has been received and considered. When an ordinary interim dividend was omitted last August it was stated that the position was satisfactory to date, but it was thought advisable to conserve cash resources. For 1949 ordinary dividend was 40 per cent against 100 per cent for the prevous 12 months.

MARKET REPORTS

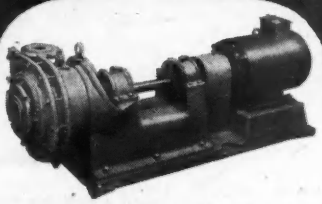
continued from page 470

ducts is dictated more by the availability of supplies than by the demand which continues strong in all departments. An active demand for the light distillates is reported and the naphthalenes are tight with little available for shipment. A good demand for export is reported for cresylic acid and creosote oil.

MANCHESTER.—Trading conditions on the Manchester market for heavy chemicals have shown little change during the past week. The soda and potash compounds are all meeting with a brisk demand, and a steady trade is being done in the ammonia and magnesia chemicals, much of the business being on export account. Prices generally maintain their firmness. In the market for fertilisers there is a good demand for superphosphates and the compounds, with a fair amount of business now being placed in sulphate of ammonia.

GLASGOW.—Business continues to be very brisk although many chemicals are now on short supply list. The export market is fairly active but here again many chemicals are in short supply.

Mitchell CENTRIFUGAL ACID PUMPS



L.A. Mitchell have long experience in the design of equipment for acid pumping, storage and distribution and will be pleased to offer their services in this direction. The centrifugal acid pump illustrated is available in a wide range of sizes and will handle all acids and corrosive liquors with the exception of hydrofluoric.

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Provided they are well bedded down, it takes a lot to disturb sound sleepers. We are not referring to large gentlemen in corner seats trying to snatch forty winks between ticket checks. Nor dare we mention their more fortunate brothers who enjoy the comparative comfort of a sleeper of another kind.

We refer specifically to the timber sleepers which carry the rails and distribute the load in most railway trackwork. With these, as with all other details of railway siding planning and construction, we have had much experience and this experience is at your service if you have any problems in this field of constructional engineering.

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SC/12

CLASSIFIED ADVERTISEMENTS

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Applicants should preferably have had experience in the operation of Industrial Gas Appliances or heat process work and should possess the Higher Grade Certificate of the Institution of Gas Engineers (Supply) or Higher National Certificate in Mechanical Engineering or equivalent qualification.

Letters of application, giving details of experience and stating age and qualifications, should be addressed to the **Chief Personnel Officer, Radiant House, Bold Street, Liverpool, 1,** to be received not later than 14 days from the publication of this advertisement.

SITUATIONS VACANT

CHIEF TECHNICAL OFFICER required by well-known Meter and Instrument Manufacturer. Applicants must possess firstclass experience in instruments and light mechanism technology with academic knowledge of physics and mechanical engineering to degree standard. Post is permanent and pensionable. Salary range, £1,000 to £1,650 per annum, depending on qualifications. Only men of first class ability and experience will be considered. Applications in strictest confidence to Chairman, Box C.A. 694, at 191 Gresham House, E.C.2.

ENGINEERS with degrees in Mechanical or Chemical Engineering are required for The Bahrein Petroleum Company Ltd., Persian Gulf, who have openings for (*a*) men not over 40 years of age with three or more years experience in oil refining, coal tar or chemical distillation plants; (*b*) graduates with experience to train in various phases of their process, design and development work. Living costs are low the company providing free board, air conditioned accommodation and medical attention. Kit allowance, and provident fund. Write with full particulars of age, experience and education to Box 4035 c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.

ORGANIC CHEMIST OR CHEMICAL ENGINEER—graduate. Preferably with experience in phenolic resins—age 26-30. After preliminary training the selected applicant would be expected to take charge of a new plant of a specialised nature now in the course of erection in the Sheffield district. Write giving particulars of education and experience and stating salary required to: Box No. C.A. 3004, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

PLANT DEVELOPMENT AND PROCESS ENGINEERS qualified in Chemical Engineering or Petroleum Refining Technology, required by Bahrein Petroleum Company, Limited. Age limit, 25-40. Two-year agreement periods with passages and paid leaves. Free air-conditioned accommodation, board and medical attention, kit allowance, low living costs. Salary according to experience. Write, with full particulars of age, education, experience, to **Box 3784, c/o Charles Barker & Sons, Ltd., 31, Budge Row London, E.C.4.**

YOUNG ENGINEER with degree standard in Mechanical or Chemical Engineering required as junior assistant by leading Chemical Engineering firm for heat transfer calculations and similar technical work. Permanent and progressive appointment with varied experience offered. Residence in London area necessary. Write stating age, experience and salary expected. Box No. C.A. 2997, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

SITUATIONS VACANT

THE Civil Service Commissioners give notice that an Open Competition for pensionable appointment to the **ASSISTANT (SCIENTIFIC) CLASS (BASIC GRADE)** will be held during 1951. Interviews will be held throughout the year, but a closing date for the receipt of applications earlier than December, 1951 may eventually be announced either for the competition as a whole or in one or more subjects. Successful candidates may expect early appointments.

Candidates must be at least 17½ and under 26 years of age on 1st January 1951, with extension for regular service in H.M. Forces, but other candidates over 26 with specialized experience may be admitted.

All candidates must produce evidence of having reached a prescribed standard of education, particularly in a science subject and of thorough experience in the duties of the class gained by service in a Government Department or other civilian scientific establishment or in technical branches of the Forces, covering a minimum of two years in one of the following groups of scientific subjects:

(i) Engineering and physical sciences.
(ii) Chemistry, bio-chemistry and metallurgy.
(iii) Biological Sciences.
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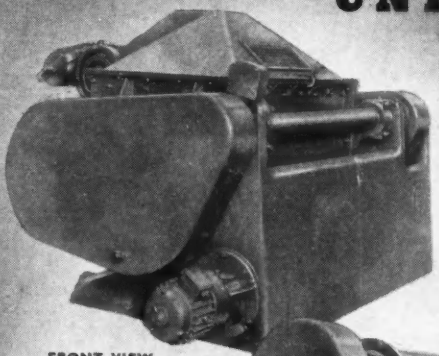

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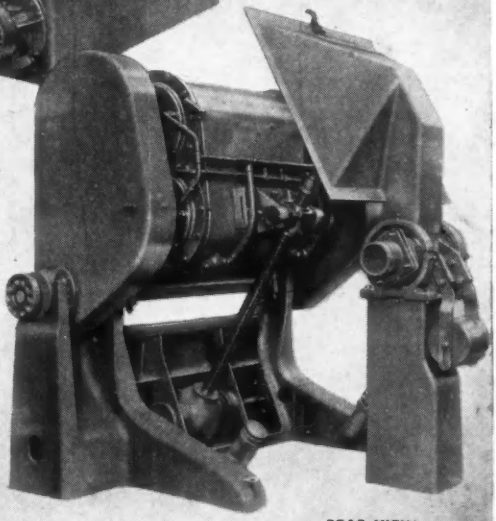

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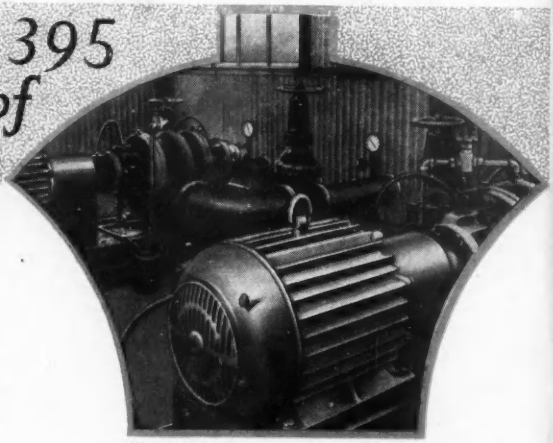

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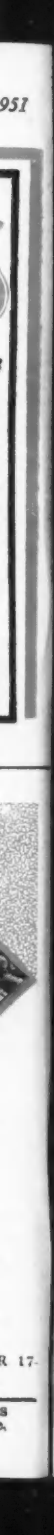
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